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Notice.

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AMERICAN MACHINIST PRESS.

Threatened Complications in the Strike Situation.

Milwaukee seems to be one of the principal storm centers of the strike situation, owing to the fact that its machinery building establishments are numerous and of considerable importance, and to the further fact that Mr. Edwin Reynolds, chief engineer of the Allis Company, is president of the Metal Trades Association; Mr. Reynolds having been, in fact, so much occupied with matters pertaining to the struggle now going on with the machinists that the visiting engineers saw very little of him during the convention.

The abrogation of what is known as the New York agreement by the Metal Trades Association, which action was based upon their claim that the machinists themselves had been unfaithful to the agreement, has led to action in Detroit which seems significant and may lead to a widespread labor disturbance and a severe and protracted struggle. This action took the form of resolutions adopted by the iron molders' organization of Milwaukee, in which they expressed sympathy with the machinists and declared their intention of supporting them in every possible way to the extent of refusing to work upon patterns made by non-union patternmakers or to make castings to be finished by non-union machinists. The resolutions also urge similar action by iron molders everywhere, and if responded to are almost certain to bring the union molders into conflict with the National Association of Foundrymen, with which they have an agreement that provides that no strike or lockout shall take place until every possible effort has been made to settle the difficulty amicably and until arbitration has also failed. How the molders can act in accordance with the resolutions referred to without violating the agreement they have with the National Foundrymen's Association is a little difficult to understand, but it is probable that the agreement will not be allowed to stand in the way of rendering aid to the machinists and patternmakers; the molders of Milwaukee at least being evidently of the opinion that the action of the Metal Trades Association is virtually an attack upon unions generally. At this writing it is impossible to say whether or not molders generally throughout the country will adopt this course; but if they do, the manufacturers will undoubtedly have a pretty serious war upon their hands. Molders, as is well known, generally rather like a fight of this kind, and have had considerable experience in them.

Why the Old Way Leads and the New Way Lags.

A number of recent contributions, together with the accompanying letters of transmissal, have been of a class and have shown a state of mind on the part of their authors which illustrate a trait of human nature that is too often lost sight of. These contributions have all been written to show their writers' method of solving some problem. In some cases the solutions have been mathematical, in others graphical through diagrams constructed on the drawing board, and in others graphical through the use of engraved diagrams or charts. They have all been alike, however, in that they represented hard thinking in their original development.

The trait of human nature to which we refer shows itself in the uniform belief of each author of such a method that his plan of solving the problem in hand is a little better than any other method in existence. The explanation of this lies a good deal deeper than the ready one of a parent's natural preference for his own offspring, and it is not merely or usually an exhibition of pigheadedness.

When a man has a problem of this class to solve and he attacks it from the bottom, finally evolving a complete solution, that solution, by the very fact that he has devoted original thought to it and has found his way out to daylight after perhaps following many blind leads that led nowhere, is more clear to him than any other can possibly be. The use of the resulting formula or the construction of the necessary diagram is to him absolutely easy, because all difficulties have been solved in the analysis which led to the formula or diagram, and no effort of the memory or of the understanding is necessary in the application. By the fact that the solution is the result of his own thought it has become a part of himself in a way which no solution by another can ever be, while if the method has been followed for some time its use has become almost automatic. When another solution, even though perhaps a much better one, is presented, close thought is necessary to understand it, and after it is understood it is only by an effort of the memory or perhaps by repeated reference to the published solution that it can be used, and the line of least resistance soon leads back to the original method. Moreover, most men take little pleasure in the solution of such problems in the abstract, and the neatness or beauty of a given solution in itself has little charm for them. What they aim for is the least mental effort in doing the actual work, and this, as we have shown, lies in the method which is the user's own.

Back of all this lies the further fact that different minds are differently constituted and differently educated and instinctively follow different methods. Some naturally turn to mathematical analysis, others to graphical construction, and some again to this and some to that method of analysis or of construction. To some the feat of memory involved in retaining graphical constructions in the mind is impossible, and they turn to the all-pervading mathematical analysis. To others an equation is an abomination and graphical construction is like a road out of a wilderness. A hobby of an old teacher of the writer was to reduce nearly all arithmetic to proportion, and this we understand is now being made the basis of a new "system" of arithmetic. Because of this different construc-

tion of different minds there can be, for many problems, no one "best" solution.

We recently heard of a well-known professor of mathematics who in his classes in analytical geometry had regularly given out a certain proposition which required a half acre or so of mathematics for its demonstration. The proposition was mentioned to another man, who would disdain to be called a mathematician, and who remarked at once that the thing was so nearly self-obvious as to scarcely need a proof, and on being pressed for an explanation he gave a proof which for his own satisfaction did not require a line to be drawn or a figure to be made, and which was so simple and so conclusive as to cause the professor of mathematics to throw up his hands in wonder and admiration. The mathematical proof was beyond the understanding of the second man to devise or even to follow, but his proof was equally impossible to the professor—not because it required greater ability than his, but because it required a mind cast in a different mold.

This is the reason why so many really valuable improvements in methods make such slow progress. It is not that men prefer the old way, but that they prefer the familiar way, the way which by long usage has become part of their mental equipment and which, to them, is both easier and simpler than other ways which may be intrinsically superior.

The Anonymous Coward.

When a letter or a contribution or paper of any kind reaches the desk of the editor the first thing he looks at is the signature. He naturally wants to know at the beginning who it is that is addressing him. If he finds no signature or finds the communication signed "One who is tired of your flunkyism," or some such courteous appellation, the letter, or whatever it may be, goes at once into the waste basket without being read, and the writer has produced no effect whatever by his writing or by the investment in a postage stamp. There is little enough time for the reading and consideration of communications whose writers are not afraid or ashamed to sign them with their own full and proper names and addresses. The reader who thinks the editor is a flunky or any other unpleasant thing has a right to his opinion. If he thinks so and also thinks the editor should be given proofs of it and states his proofs in a decent manner and over his own name and address his communication will be considered and in most cases answered; but the anonymous coward is too contemptible for any notice whatever and we have no time to waste upon him.

Nine Hour Day.

The L. S. Starrett Company, by its president, from whom the company takes its name, has issued a circular to its employees, informing them of the adoption of a nine-hour day without reduction of pay in the factory, which reduction of time is to take place June 1. It is stated in the circular that this is done voluntarily, no demand or even request having been made for such reduction by any of the men, the language of the circular being:

"We are of course in business to make it pay. But we have an interest in the physical, intellectual and moral welfare of all working with us, and rejoice in their prosperity and progress. Our business is and has been steadily increasing in volume and importance, and we now take pleasure in sharing with you the prosperity which you and we together have earned. Beginning the first day of June next nine hours a day, or 54 hours per week, instead of 60 as at present, will be the rule in this factory without reduction in pay."

Packing Goods for Foreign Markets.

United States Consul Fleming, of Edinburgh, has made quite a study of the matter of packing goods for foreign markets, and has collected much information as to the best methods, covering the entire field of merchandise. Speaking generally, he says:

"The importance of the proper packing of goods for export is a matter concerning which there is no room for two opinions. If it were not common knowledge that the arrival of merchandise at its destination in good condition is as essential to foreign business as it is to home trade, the fact that space in the Paris Exposition was devoted to object lessons on packing would show that the commercial world recognizes it as a vital part of the process of getting and holding any market. The manufacturer or exporter who wins a reputation for the best packing of articles has a distinct advantage in the foreign trade, prices and quality of goods being satisfactory."

Of the more than one hundred items of merchandise specifically mentioned in the report only two or three have direct interest for us. As a rule, the materials of which American crates for bicycles are made lack proper strength and the same is true of the cases in which bicycle parts are shipped. The cases used for hardware, however, are said to be notably strong, and the best material is used in making them. The best practice in packing machinery—heavy or light—is to firmly fix every piece to the case, either by bolts going through the case, or by battens arranged inside to securely lock the various pieces in position. With heavy machinery, no loose material should be used in any case. The American, as well as the Scotch, packing of machinery in general has been on this plan, and is everywhere commended. At most European ports, there is a decided objection to heavy bundles of iron or steel or other metal. Care should be exercised in packing to keep the bundles a moderate weight. In shipping wire the obvious requirement is to perfectly secure the ends, yet this is not always done. For nails, bags are best, and for Great Britain they should always contain 112 pounds each.

International Labor Bureau.

Switzerland, a country which serves as a neutral ground for the headquarters of several associations for promoting international welfare, and which is itself active in fostering such movements, has lately taken the lead in a society for the betterment of labor conditions throughout the world. May 1, of this year, according to a report from Consul George Gifford, the International Labor Office was to begin its work in Basel.

One of the first suggestions in this direction was made as long ago as 1876, by Col. Emil Frey, a Swiss statesman, known in America as a volunteer in our civil war, afterwards as Swiss minister in Washington, and finally as President of the Swiss Republic. He suggested that international conventions establish uniform conditions of labor in all industrial communities, since the danger resulting from foreign competition is a great obstacle in the way of isolated social reform. But when, five years later, the Swiss National Council unanimously voted to begin negotiations with other countries for this purpose, the answers were all unfavorable. Various other attempts were made to embody the idea, including an international conference at Berlin, called in 1890 by the German Emperor, and one at Zurich in 1897, convened by the Swiss Workingmen's Society. As the result of a congress held soon afterwards at Brussels and of a meeting at Berlin in 1899, the International Union for the Legal Protection of Workingmen was formed, its rules being approved in a conference at the Paris Exposition. The Swiss National Council is aiding the society financially, and two other governments also are disposed to assist. Prof. Bauer, of the University of Basel, and formerly of the University of Chicago, has charge of the international office, which is situated in a public building, Clarahof, Rebgasse 1.

The announced objects of the association are, briefly, to publish the labor laws of different countries, with their interpretations, besides other matter relating to labor; to give information to governments, labor organizations, etc., as well as to private members of the society; to promote suitable labor legislation, especially by giving expert advice in relation to it. In order to do this, the society will have an important work of investigation to perform. A congress will be held annually. The first meeting of the association will take place on September 27 and 28, 1901, in Basel; its main purpose will be to permanently constitute the association. In the meantime national sections will try to promote interest for social reform in their respective countries.

Modern Interchangeability.

Much is said from time to time about "repetition work" and working to standard patterns; but even among those who should know better, there is often much vagueness as to the meanings attached to these terms. There is, of course, nothing new in the adoption of certain standard dimensions, nor in the making of parts of similar engines or machines so that they are interchangeable. Such interchangeability of parts has been common—in locomotive practice, at all events—for over forty years. But there is something new in the most modern methods of carrying out such practice, and these methods have begun to exercise an important influence in many ways on the procedure in engineering works. In considering modern methods and comparing them with older practice, we are at once struck by two special differences. The first of these is the definiteness with which the sizes of parts are now fixed. The fitting of one part to another is no longer a question of working to gages of which the absolute sizes are unknown, but of working to sizes which are definitely fixed and stated, and which are at any time capable of reproduction. Moreover, the limits of deviation from these exact sizes are rigorously fixed also. To carry out this system means the general provision of instruments for accurate measurement, which were formerly only to be found in a very few special establishments, such as those engaged in the manufacture of small arms and ordnance. It means also the possession of skill in the use of such measuring appliances, and a cultivation in the workmen of a thorough appreciation of the value of small units. It further means the establishment of a thorough inspection of the work turned out, and the prompt rejection of any pieces which do not come up to the standard of accuracy determined upon.—Address of President William H. Maw, Institution of Mechanical Engineers.

The Coming Charleston Fair.

The South Carolina Interstate and West Indian Exposition will open December 1 of this year and close June 1, 1902. Its purpose is to advertise the South. The neighboring new acquistions of this Government, as well as the Spanish-American republics in a general way, are comprehended in the scheme. The plans show quite extensive grounds with many buildings, among them being a building for machinery of all kinds, including agricultural implements. There will also be transportation exhibits and electrical exhibits, among them a "complete display of electric vehicles." It is intended to make the West Indian exhibit larger than any other of that description yet attempted. Features of it will be samples of the goods sold there by European manufacturers, marked with their wholesale and retail prices, for the benefit of American competitors, and also exhibits of the different packages that seem to be preferred by the various trades. Another interesting feature of the Cuban display will be the garrote, accompanied, it is expected, by Valentine, Gen. Weyler's executioner, who will, we dare say, give frequent demonstrations of its utility. The manager of the exhibits and concessions department of the fair is E. L. Tessier, Jr.

A Joke on the United States Patent Office?

The following item is from the "London Chronicle":

"Some patent stories were told last night at the Society of Arts. One of the best came from Prof. Ayrton, and was told at the expense of the American Patent Office. Some time since the professor wished to protect a new kind of varnish, but the Washington authorities refused him a patent, on the ground that he had not supplied a drawing or diagram of the varnish! In the end the professor drew three vertical lines, and explained them in this way: A and B represent the glass and C the varnish. Then the patent got through."

This is funny, of course; but it can't be correct. The patent office frequently issues patents for "compositions of matter," and in such cases drawings are not required, although usually specimens are. If the patent had to do with the application of the varnish that would be another matter and the drawing would have been proper, but that would have killed the joke.

Messrs. Carnegie and Schwab have cooperated before and we are not sure but that Carnegie's gift of $10,000,000 to make tuition free in Scotch universities is a deep laid scheme to disqualify all young Scotchmen from becoming efficient competitors with American steel works by giving them all a college education.

Commercial Review.

New York, Monday, June 3.

THE MACHINERY MARKET.

In spite of the grip that the machinists' strike has taken on machine-tool manufacturing conditions, as a whole, the effect upon trade coming to local houses has been comparatively small. The labor troubles have shown some results, it is true, in the way of hanging up deals and their influence is detected in the small tool or supply line. Trade is quieter now than it has been for some time past, reports one of the biggest market factors. Yet inquiry of one and another leads to the conclusion that orders are coming in pretty much as if there were no strike on. The inability to get prompt deliveries from factories where the men are out leads to drafts upon dealers' stocks, and if any jobber or manufacturer has an inconvenient quantity of tools on hand the present time will serve him in good stead to get rid of them. There is hardly likely to be a tool famine unless the strike hangs on a good while, for, in addition to the volume of machines in stock, there is no insignificant producing capacity in those factories which have not closed down or which have resumed. The Brown & Sharpe Manufacturing Company's is one of the former sort. At the Niles Tool Works in Hamilton, Ohio, the differences have been adjusted and the men are back, although a strike is still on at the Pond plant of the Niles-Bement-Pond Company.

The local office of a leading pneumatic tool company notes some subsidence of trade attributable to the strike. One of its men who was traveling in New England found conditions there such that his tour proved a failure.

It looks as if the Buffalo Exposition might prove a good thing for the toolmen who are participants. A selling company which is managing a big display of the tools of a number of manufacturers which it represents is quite gratified at the attention that the exhibit has received and at the inquiries already received as a result thereof. The Paris Exposition largely failed of its results as an advertising scheme for American machine tools, because the foreign demand had already run its course. It is hardly to be thought that the same is now true of home demand. And, further, if the machine tools at the Buffalo show are visited by many travelers from the Spanish-American countries they may catch a flood tide whereas those at the Paris fair caught an ebb one.

Among machinery shipments made about this time is a 12-20-foot extension boring mill which the Niles-Bement-Pond Company is sending to Graham Brothers, Stockholm, Sweden. The Garvin Machine Company, which got a large slice of such of the Rock Island Arsenal contracts as were given out, has just been shipping a carload of machinery there.

There is a cable report from London that the British Government has decided to introduce new American labor-saving machinery such as pneumatic drilling and riveting machines, etc., at the Portsmouth dockyards. It was attempted to learn more of this at the New York office of a pneumatic tool company which has been successful in foreign trade, but the statement was there made that the contract, if they had received it, had been attended to at the London office and no advices had reached them in this city.

We published last week an extract from a consular report to the effect that there seemed to be a little improvement in the German demand for special classes of American goods. A man prominent in the German-American machinery trade tells us that he finds business quite satisfactory as regards some special machines.

The Catawba Power Company, Rock Hill, S. C., is establishing a plant for distributing water power electrically. An order has just been placed for four rope drives of 1,175 horse-power each to be built by the Webster Manufacturing Company, of Chicago. They will connect the water wheels with the generators. These generators will be of General Electric make. The water wheels were ordered earlier of the Holyoke (Mass.) Machine Company.

The report of the Cramp Ship and Engine Building Company for the year ended April 30 shows gross earnings of $7,319,000 against $7,791,560 last year. With cost of labor, material, etc., deducted, this leaves a balance of $743,000, which is $244,490 less than that of a year ago. The quarterly dividend of 1¼ per cent. has been declared.

J. B. & J. M. Cornell, of this city, which concern secured the contract for the erection and equipment of the Mexican Sugar Refining Company's $400,000 plant, have just decided on the subletting of a number of the contracts. The Mexican company, of which Isidore Hechinger of New Orleans is president and J. B. Craven of the same city is vice-president and chief engineer, has acquired land on the Papaloapam River, in the State of Vera Cruz, Mexico. The plant will be a 1,000 horse-power one, capable of handling nearly 1,000 tons of cane per day. About everything but the mills and crushers will be driven by electricity. The Birmingham (Ala.) Machine & Foundry Co. is to build the mills and crushers, also the engines for the mills and crushers and for the electric plant. Those to operate the mills, etc., will be of 400 and 250 horse-power. The Stirling Company, of Chicago, will build the boilers. The contract for the pumps has been allotted to the Worthington arm of the International Pump Company. The centrifugals will be of the Weston type. The 1,000 horse-power feed water heater will be a Cochrane, and the Coatesville Boiler Works will supply some sixty steel tanks. The Crocker-Wheeler Company is to furnish four 100-kilowatt generators and some fifteen motors, three of 50 horse-power, two of 30 horse-power and a number of smaller ones. These motors will drive the pumps, centrifugals and other machinery. The contract for the equipment of a repair shop, which will include engine, boiler, lathe, planer, bolt cutter, pipe-threading and blacksmith tools, etc., has not yet been sublet by the Cornell people, who will turn out the structural material for the building and various other equipment at their Cold Spring (N. Y.) works. As the Mexican company has acquired option on other land almost adjoining its present property, it is expected that the letting of some further contracts for equipment will be made necessary in the near future.

A machinery syndicate, or trust, with a capital of 12,000,000 francs, has been formed in Spain, according to a French paper. Its object is to obtain the greatest development and all possible perfection in mechanical construction in associating the following factories: "Machinerie Guipuzcoana," of Beazain; shops of "Zorroza," of Bilbao; "La Constance," of Linarés, and "Cifuentes y el Stoldtz," of Gijon. They will be so operated that each will concern itself with a specialty or particular branch. In this company are the Marquises d'Urquijo and Aldama; Rodas, of Bilbao; Olavarria, of Gijon, and other prominent capitalists.

Consul-General Guenther, of Frankfort, says that, according to "Informations et renseignements de l'office national du commerce exterieur," a new electrical company, the "Sociedad General Gallego de Electricidad," has just been formed in Madrid, Spain, with a capital of 2,000,000 pesetas, and two of its engineers, Ernsto Presser and Adolfo Barbe, of Madrid, have been instructed to procure the necessary machinery. According to the same authority, another company has been formed at Saragossa—the "Sociedad de Aprovechamiento del Rio Gallegos"—with a capital of 3,500,000 pesetas. This company will require a great deal of machinery and apparatus.

CHICAGO MACHINERY MARKET.

Until Friday last week Chicago was practically exempt this year from strikes in the machine shops. The disagreement between the executive boards of the National Metal Trades Association and the International Association of Machinists at their conference held here on Wednesday on the wage issue precipitated the withdrawal of the men from the shops. Indications are that it will be a fight to a finish. At the manufacturers' conference Wednesday there was one division of the representatives present who counseled no recognition of the machinists' association; another division, and one which proved to be in the majority, favored the recognition of the association, but insisted that the proprietors should retain the right to regulate the number of apprentices, decide the sufficiency of a cause for the dismissal of a machinist, and to establish their own wage scales. Thirty or forty new members were added to the National Metal Trades Association last week, and the organization is said to be stronger than ever. The plan adopted is for each manufacturer hereafter to deal directly with its own men.

The effect of this complication upon business can only be surmised. June opens with trade in splendid condition. May was a month equally as good as any of its predecessors during this year and the makers of boilers and engines especially have been favored with a good trade. Street-railway work continues the leader in importance. One engine man says there is in Ohio at present a demand for one hundred engines for inter-urban railway service. Quite a number of deals, it is thought, will be closed in that State within the next few days.

The E. P. Allis Company has sold to the Cleveland City Street Railway Company a 2,250 horse-power compound engine and one of 3,700 horse-power to the Metropolitan Elevated Railroad Company, of Chicago.

Elevators are asking for considerable power. Among recent orders placed at the Chicago office of the Atlas Engine Works were two 500 horse-power condensing engines for a 2,000,000 bushel Grand Trunk elevator at Portland, Me.; one 800 horse-power cross compound for the Rialto elevator at South Chicago. The same company, among its orders outside of elevator work, has secured one for a 250 horse-power cross-compound Corliss from the Stover Manufacturing Company, Freeport, Ill.

From manufacturers the inquiry for boilers and engines is very good and many sales have been made. The present situation is regarded as somewhat critical, in that many plans for improvements now about ready for closing may be put off for the year, if much difficulty appears in the way of obtaining expected deliveries.

Quotations.

NEW YORK, Monday, June 3.

Pennsylvania Foundry Pig Irons, Jersey City delivery, good brands:

No. 1 X	$15 40 @ $16 25
No. 2 X	14 90 @ 15 25
No. 2 plain	14 00 @ 14 50
Gray forge	13 75 @ 14 25

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 50 @ 15 75
No. 2 foundry, or soft	15 00 @ 15 25
No. 3 foundry	14 50 @ 14 75
Foundry forge, or No. 4	14 25 @ 14 50

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.58 @ 1.65c.; from store, 1.80 @ 1.90c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 1.90 @ 2.00c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

Copper in carload lots—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16½ @ 16⅝c.

Pig Tin—28¼ @ 28½c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—4c., New York.

Antimony—Cookson's, 10⅜ @ 10½c.; Hallett's, 8¾c.; Hungarian and Italian, 8⅝c.

Lard Oil—Prime City in jobbing lots, 65 @ 67c.

The Shops of the Willans & Robinson Company at Rugby, England.

One of the best known workshops in Great Britain is that of the firm of Willans & Robinson, the existence of which firm dates back only about twenty years, but during that time it has attained a degree of eminence quite unusual; especially in Great Britain, where a business is seldom built up so rapidly. This success is, I believe, founded entirely upon the high order of merit that has always characterized their product, together with the fact that in their shop administration as well, they have been ready to take hold and utilize the most advanced ideas and have pursued a remarkably broad-minded policy.

The Willans central valve engine is well known to all who are at all well informed regarding steam-engine matters, and it was fully illustrated and described in the "American Machinist" of October 26, 1893, which description shows that it is a vertical, single-acting engine, remarkable for its high steam economy, very quiet running at high speeds and for its method of steam distribution, which is by means of a hollow piston rod containing suitable ports and piston valves which move within this hollow piston rod, there being two connecting rods for each set of cylinders and the eccentric being located on the crank-pin between the crank-pin bearings. The usual form of cross-head is replaced by a piston which works in a cylinder placed below the steam cylinder, air being confined above this piston to act as a spring buffer and keep all the moving parts down to their bearings at all times.

Four years ago when I was in England the new shops of the firm at Rugby were just getting fairly under way. The older shops are at Thames Ditton, which is on the Thames river above London and not far from Windsor. They were outgrown and I think the intention was when the new Rugby shops were built to abandon the Thames Ditton shops and concentrate the manufacturing at Rugby. The growth of business has, however, been so rapid that both the old and the new shops have been kept going at their full capacity and the new ones have been enlarged several times. In fact, an addition was being built to them four years ago before they were fully in operation and they are just now being extensively enlarged.

Just about a year ago some of the members of the American Society of Mechanical Engineers were royally entertained by the firm of Willans & Robinson at the Rugby shops and saw a great deal in and about them that was of the greatest possible interest. At page 712 last year I gave some account of this visit to the works and attempted to give some idea of the excellent way in which the entertainment was carried out, but left some of the most interesting things to be described when I should be able to present photographs of them, and these photographs have only recently come to hand.

The present "limited" (or, as we would call it here, incorporated) company was at first a simple partnership between the late Mr. Willans, from whom the engine takes its name, and Mr. Mark Robinson, who is chairman of the present company. At first their specialty was a small high-speed marine engine, which was the first really successful one to be brought out, and in the early days of electric lighting was much used for this purpose. Various improvements were made from time to time in the engine, and the final outcome was the Willans central valve engine, which is to-day the firm's exclusive product. The business increased very rapidly after this engine was put upon the market, and finally a site was purchased at Rugby, as there was insufficient room and no facilities at the old works at Thames Ditton. In the construction of the new works the principles which have always actuated the company have not been departed from, and they are laid out with the object of the production of the highest possible quality of work, standardization of the firm's manufactures in certain definite sizes, strict accuracy and interchangeability of all corresponding parts of the same size and the adoption of all means of saving labor and cheapening production, and also of providing the best accommodation possible for the men.

The works are situated upon a piece of land, of about 23 acres in extent, which adjoins the London & North Western Railway, near Rugby Station. It was the company's aim in laying out the works, firstly, to arrange them so that the raw material entered at one end and in going through the various processes traveled continuously in one direction through the works until it emerged in the shape of finished engines, or portions of engines, ready for despatch at the other; and, secondly, to make provision for easy extension, should it become necessary, as seemed very possible. The buildings therefore all front upon a road which extends across the entire site, running parallel and close to the lines. The order of the principal departments, starting from west to east, is as follows: (1) foundry, with storage for coke and iron; (2) casting stores, (3) machine shop, (4) manufactured stores, (5) erecting shop, (6) packing and forwarding department. Beyond these again are the pattern shop and pattern stores and the general offices, while the testing department is housed in a separate building some little distance away and connected with the erecting shop by a tramway. The buildings are all constructed upon one uniform plan; they are one story in hight and are divided into bays running north and south, separated from each other by lattice steel stanchions which carry girders for cranes and shafting. They also carry the roof, which is of the weaving-shed or saw-tooth type, with the light entering from the north and the ridges and gutters running east and west. The buildings are incapable of extension sideways, but they may be lengthened backwards to the south. The machine shop has already been lengthened in this way, and the foundry and the shop formerly intended for boiler making are now being extended in the same way. At the western end of the works stands the foundry, with coke and iron stores at one side, down the center of which runs a railway track, from which the trucks discharge. At this side also are the two cupolas and the blowing engine. The building at present covers 22,000 square feet, which will be extended to 57,000 when the extensions in progress are completed. It will then consist of one 30-foot bay for pneumatic molding machinery, etc.; one 60-foot bay, 200 feet long, for large castings; two 40-foot bays, 400 feet long, and one 25-foot bay to b used partly as a casting store and partly as a pattern store. Among the special appliances in use in the foundry may be mentioned the pneumatic molding machine and the Piftin stoves for artificially drying the molds by means of a current of hot air.

The next shop is the machine shop, which contains also the smiths' shop, manufactured and general stores, erecting shop and works manager's office, and which, when completed, will have a frontage of 500 feet and a depth of 240 feet. It will consist of sixteen bays. Portions of Nos. 1 to 4 are already completed. No. 1 contains smiths' forges, and is separated from the remainder of the shop by a wall. The existing portions of Nos. 2 and 3 will contain crank-shaft lathes, and No. 4 a brass-finishers' shop, and the back portion will be devoted to the heaviest of the new tools. No. 5 is a new bay formed by covering an open alley between the existing buildings. It contains at present only a 10x10-foot planer (made by the Niles Tool Works Company), under a temporary shed. No. 6 is a bay, 40 feet wide, containing the larger tools at present at work. Attention may be drawn to the large double-headed vertical milling machine seen in Fig. 10, which is used mainly in milling the surfaces of the bases of the engines. This tool has two standards, each with a vertical travel of 6 feet. The bay also contains two very fine vertical boring machines, horizontal boring machines and planers of various sizes. Nos. 7, 8, 9, 10 and 11 are machine bays, each 22 feet wide. They contain some fine crank-shaft lathes and boring mills, as well as smaller tools, including cylinder boring lathes, shaping and slotting machines, radial and other drilling machines, etc. No. 12 is a fitting bay for putting together steam gland boxes, connecting rod brasses and the few articles which are usually fitted before being sent into store. It is also used for assembling orders for spare parts previous to shipment. Nos. 12 and 14 are the manufactured stores

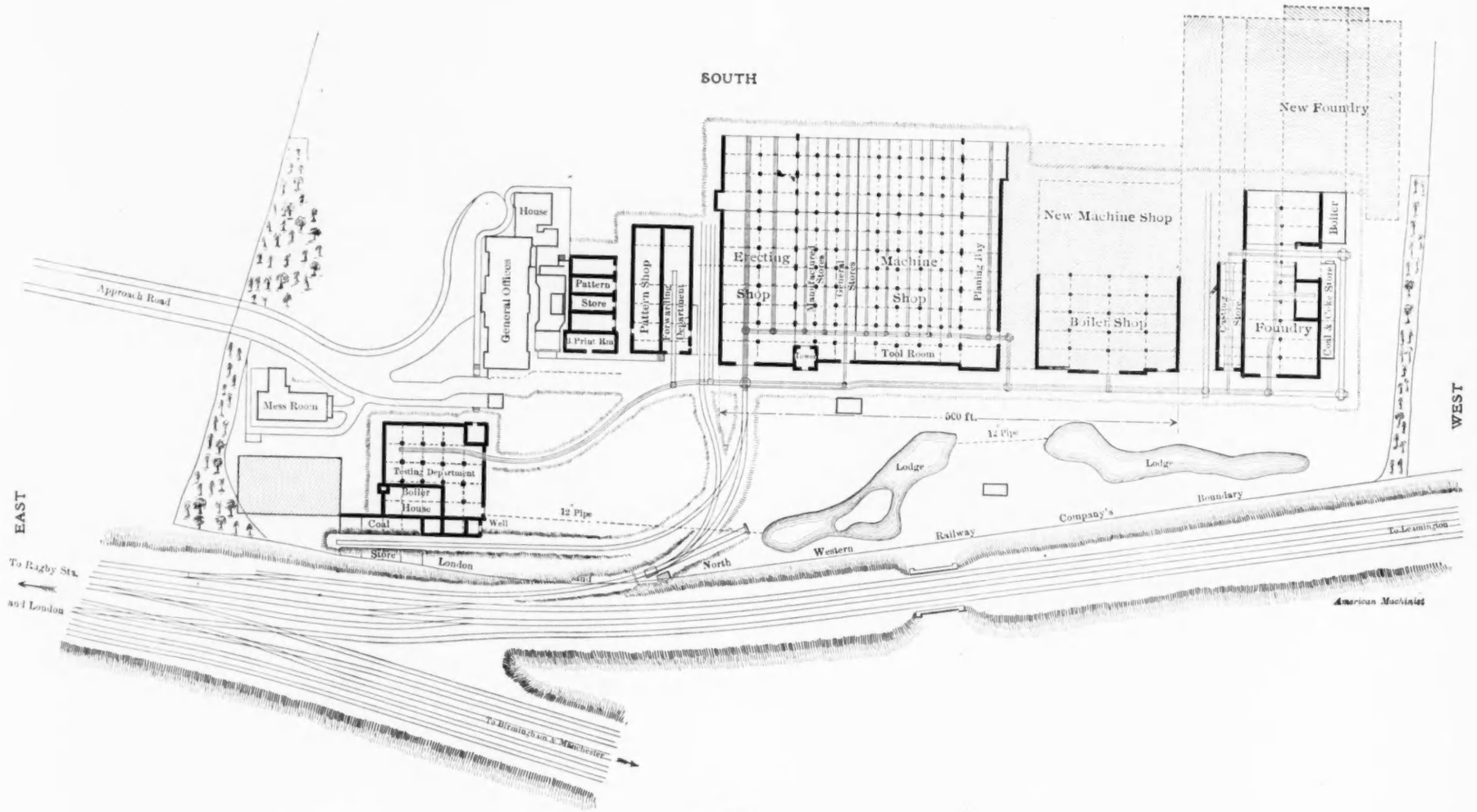


FIG. I. GENERAL PLAN OF WILLANS & ROBINSON WORKS, SHOWING RECENT ADDITIONS.

bays, where all finished parts are brought first for inspection and then for storage. Nos. 15 and 16 are the erecting shop bays, each at present 240 feet deep and 40 feet wide. Each will be lengthened towards the south by 80 feet, and No. 16 will be increased in width to 60 feet, and will be about 12 feet higher than the remainder of the erecting shop, which is itself higher than the rest of the machine shop, from which, though forming part of the same building, it is completely divided by a wall.

Next to the large extension of No. 16 bay, and behind the forwarding department, will be placed the new power-house, which will contain the engines and dynamos for the lighting and the electric driving of all the cranes as well as of the machines in the foundry and the new extensions of the machine shop. The present shop will continue to be driven temporarily by an existing engine and boiler situated in the front of the building—that is, at the north end of the bays; the remainder of this end of the shop is devoted to the tool and gage department and the various stores. An overhead gallery contains the works manager's offices.

Adjoining the erecting shop on the east is the packing department and loading-out shed which is commanded by a traveling crane and traversed by two lines of

FIG. 2. VIEW OF OFFICE AND NORTH SIDE OF SHOP BUILDING, AT THE RIGHT—WILLANS & ROBINSON SHOPS, RUGBY, ENGLAND.

FIG. 3. "THE BOARD ROOM," WILLANS & ROBINSON.

rails, one of standard gage communicating with the company's siding and running alongside a platform in the shed, and the other of 3-foot gage for convenience in bringing goods alongside the trucks. The pattern shop forms one building with the packing department and is adjacent to the pattern stores. The packing and pattern departments are kept entirely separate from the remainder of the works to minimize the danger from fire.

FIG. 4. MARK ROBINSON'S OFFICE.

A tram line with 3-foot and 18-inch gages runs along the entire front of the works, with turntables and branches leading into the various shops, and similar lines run along both ends of the machine shop and erecting shop with branches down the different bays.

A siding from the railway, with a large weighbridge at the entrance to the company's premises, runs direct to the foundry for the supply of raw materials, and also into the erecting shop. A line also connects the testing department with the erecting shop.

THE TESTING DEPARTMENT.

The testing department is separate from the rest of the works. The floor is of blue brick with grooved girders upon which the engines are bolted, and pits are provided for the reception of flywheels or dynamos which project below the engine bed-plates. Steam is supplied by four 300 horse-power Niclausse boilers made by the company, and there is a very complete system of swing pipes by which engines can be connected to the mains. The energy developed is absorbed by means of resistances if the engine is driving a dynamo, or by a brake. One of Froude's water brakes having a capacity of 700 horse-power is used for the larger engines. For making consumption tests the exhaust steam is condensed in surface condensers placed where required and conveyed in pipes to a large tank placed upon a weighbridge and capable of holding some five tons of water. The arm of the weighbridge is placed in an office in which are also collected the electrical measuring instruments and the bells for signalling to the attendants upon the engine under test, so that complete control of a trial is concentrated in one spot. The system of weighing the exhaust steam is believed to eliminate all sources of error in measurement, since only the steam actually used by the engines is taken account of and the engineers believe that results are obtained far surpassing both in speed and accuracy anything possible under the more usual system of weighing or measuring the feed water.

PARTS OF ENGINES STRICTLY INTERCHANGEABLE.

In accordance with the policy of the company from its earliest days, all the firm's productions are made in standard sizes and all corresponding parts of the same size are interchangeable. Everything is made for stock and there is now a large number of standard sizes ranging from 50 to 2,000 horse-power, and a complete automatic system for keeping up the stock. The principal parts of each size are always the same, but varying sizes of cylinders and pistons can be fitted to meet the different conditions of working. The different parts are always made in quantities and a system of jigs, gages and templets is maintained; a special department, forming part of the machine shop, is set aside for their manufacture, and storage. All special tools also are made in this department which is provided with standard measuring instruments that have been compared with the standard yard and meter. Gages and tools are issued from this department and returned to it when done with. All completed parts are inspected by the manufactured stores inspector before being passed and are then placed in stock. He is provided with a drawing of every piece, and on every dimension of each standard part certain limits of error only are allowed. Pieces not conforming to these limits are set aside with a report for further examination by a director, whose decision is final.

SOME TESTS OF ACCURATE MACHINE WORK.

The following instance will enable an idea to be formed of the accuracy attained.

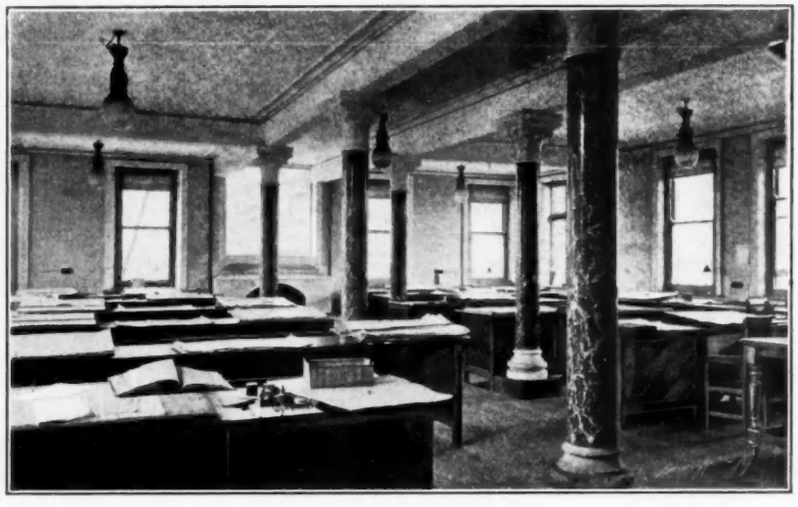


FIG. 5. THE DRAFTING ROOM.

The bore of a cylinder must not be less than standard in any case nor larger by an amount greater than .0005 inch per inch of diameter in any part of the bore. Any cylinder which has passed the manufactured stores test will, if inverted and placed upon a surface plate, allow the corresponding plug gage when inserted at the other end to float upon the contained air, the cylinder being clean and dry. The

gage will spin quite easily in the cylinder, but it will not sink for several hours, and if it be lifted by a crane the cylinder and the surface plate will go up with it. This also tests the accuracy of the facing on the cylinder head, which is depended upon in these engines for making the joint between one cylinder and the next, no jointing material whatever being used.

At the time when the engineers were going through the works a 20-inch cylinder, taken from the stores, was being used to show how they stand this test for accuracy, and it was generally agreed to be a very remarkable exhibit. The cylinder stood upon the surface of the plate and the gage, which was a disk of cast iron with an edge, I should judge, about 2 inches thick, was placed in it. There was no opening in the gage, but there was a pet-cock which could be opened to let the air below escape. When I first came upon the exhibit the man was spinning the gage around upon the confined air simply by placing his finger upon it, and there was no perceptible downward movement of the gage within the cylinder. Then he got up and stood upon the gage. It sank within the cylinder until the air was compressed sufficiently to sustain his weight, after which there was no further perceptible sinking except when he stooped and opened the pet-cock. This he did several times, and there was always a corresponding descent of the gage and a prompt stoppage when the pet-cock was closed. He thus brought the gage near the bottom of the cylinder, showing that it fitted equally well at all points; and finally, stepping off, he hitched the hook of a crane into an eye-bolt screwed into the center of the gage and upon hoisting, the gage rose within the cylinder until the air pressure below it was reduced below that of the atmosphere sufficiently so that the atmospheric pressure on the bottom of the plate lifted the plate and the cylinder and they hung there in the air. Then he let them down, opened the pet-cock, hoisted the gage out, and, by applying my finger to the edge of the gage and to the surface of the cylinder both inside and on the bottom flange where it had rested on the plate, I satisfied myself that it was dry—*i. e.*, there was no oil upon it and the surfaces were precisely as they had left the boring and turning mill. I consider it the best job of tooling I have ever seen. The illustration, Fig. 14, shows the gage suspended on the crane hook with the cylinder and surface plate hanging from it as described. The particular cylinder that I saw tested thus had been bored and faced. I was informed by the man, on a Bullard boring and turning mill. But they bore cylinders in a variety of ways and on a variety of machines (of British and American make), and all of them are stated to be capable of standing this test equally well.

Another very impressive sight witnessed by the engineers is shown by the photograph, Fig. 7, where the pistons and the central hollow piston rod or trunk that contains the valves have been built up in the usual way out of parts some of which were made in the Thames Ditton shops and others in the Rugby shops, but they all fit together perfectly without doctoring of any kind and the assemblage could have been used in an engine as it stood. The inscriptions on the guide-post hands show the shop in which the corresponding part was made and the date on which it was made.

At another point a man had some rings, made, I think, of cast iron and used for some part of the engine, I do not now remember what. There were 8 of these rings and they were about 2½ inches diameter and ¾ inch wide. They were piled up in two piles upon a surface plate, as shown by the sketch Fig. 15, and a straight-edge was laid across the two piles, as shown, so that it touched at four points. Now it is evident that in order to have it touch at all four points the two piles had to be of precisely the same hight and the four points of contact had to be in the same plane. This could be arranged for perhaps if the rings varied in thickness and were not true sideways and if a man had sufficient patience to arrange them and then knew enough to let them alone; but this man had pieces of tissue paper under the straight-edge at all four bearing points to show that there was a bearing there, and then he transposed the piles and transposed any of the rings and turned them in any and all positions and the pieces of tissue paper were all pinched at all times, showing that all the rings were precisely of the same width and that all of them were true on the sides, *i. e.*, of the same width throughout within a very small limit. I think there are very few engine shops anywhere that make parts of engines and place them in stock, which parts will stand any such tests as those described.

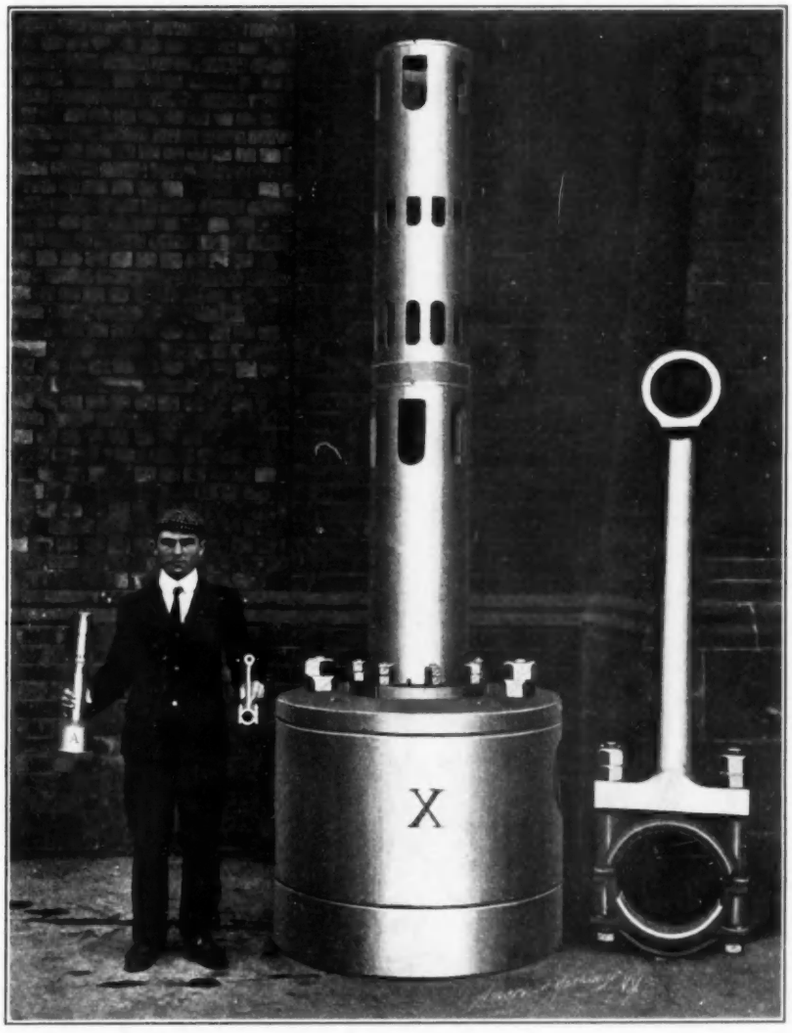


FIG. 6. LARGEST AND SMALLEST TRUNK PISTONS AND CONNECTING RODS.

METHOD OF MAINTAINING STOCK.

A certain minimum stock of each part of all sizes is aimed at, sufficient to provide for a pre-determined number of engines, and when it falls below this, through the issue of parts to engines on order, the stores inspector advises the works manager who then passes an order

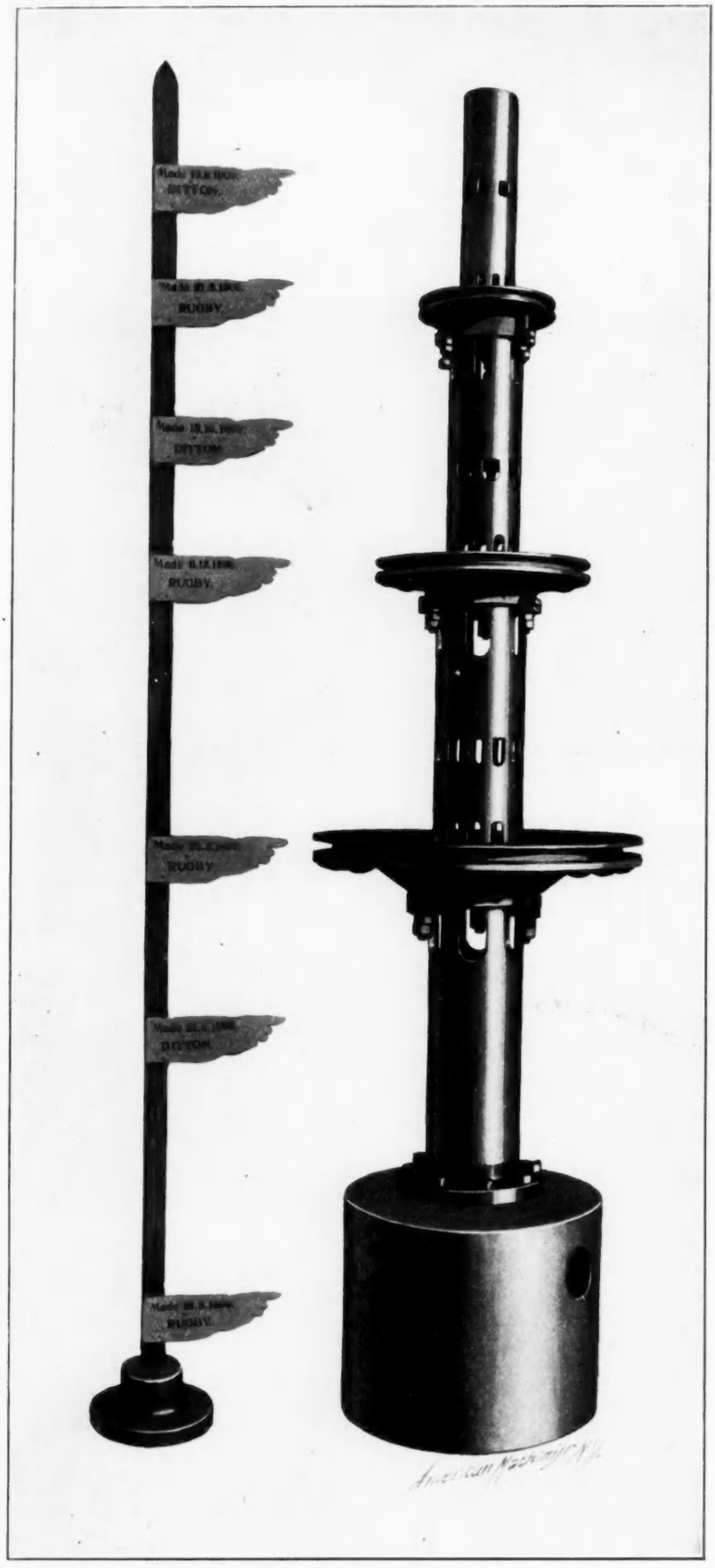


FIG. 7. AN EXAMPLE OF INTERCHANGEABILITY.

to the works for a fresh batch to be put in hand. The work in the shops is therefore regulated by the actual quantity and sizes of the engines turned out, and a stock of complete engines is thus automatically provided for. Upon an engine being ordered by a customer, a list of all its parts, standard or otherwise, is issued by the drawing office to the works manager, who draws the standard parts from the manufactured stores and puts in hand the non-standard parts, or, if they have to be obtained from outside firms, requisitions them from the orders department. This list forms also a permanent record of the engine and enables spare parts to be supplied promptly and accurately. Customers can be furnished with numbered sectional lithographs giving the names and numbers of all parts of a Willans engine and it is necessary only for them to state the number of the engine and the numbers of the parts required.

AMICABLE RELATIONS WITH THE MEN.

In dealing with their workmen the company have adopted the premium system as far as possible. Every standard part has a certain "reference rate" as a basis of payment, and if the workman produces it more cheaply the difference is divided in equal proportions between himself and the company. Certain regulations are in force for preventing the arbitrary cutting down of rates and so depriving the workman of his reward for increased skill, and the arrangement has been found to work satisfactorily on both sides. In the great engineers' strike in 1899 not a single man left the company's employment and the only trouble experienced was from the difficulty of obtaining raw material.

There is a voluntary sick club in the works, to which the company contribute annually a sum equal to the men's subscriptions. The surplus funds, including the company's donation, but less a certain amount to provide for current needs, are divided among the subscribers at the end of each year. The company have built a mess room which is in charge of an attendant, who in return for a small fixed wage is allowed to supply meals at certain rates and is also bound to cook the men's own provisions. Bathrooms and lavatories are provided in the basement of this building, which also serves for meetings, entertainments, etc.

The unoccupied portion of the company's premises is let as allotments to the workmen at a small rental, upon condition of its being resumed by the company should it be required for any other purpose.

F. J. M.

Prof. Dayton C. Miller, of the Case School of Applied Science, has the largest flute in America. It was made to order in London, is much longer and larger than a common flute, and its lowest note is the tenor G—that is, the first G below middle C on a piano.

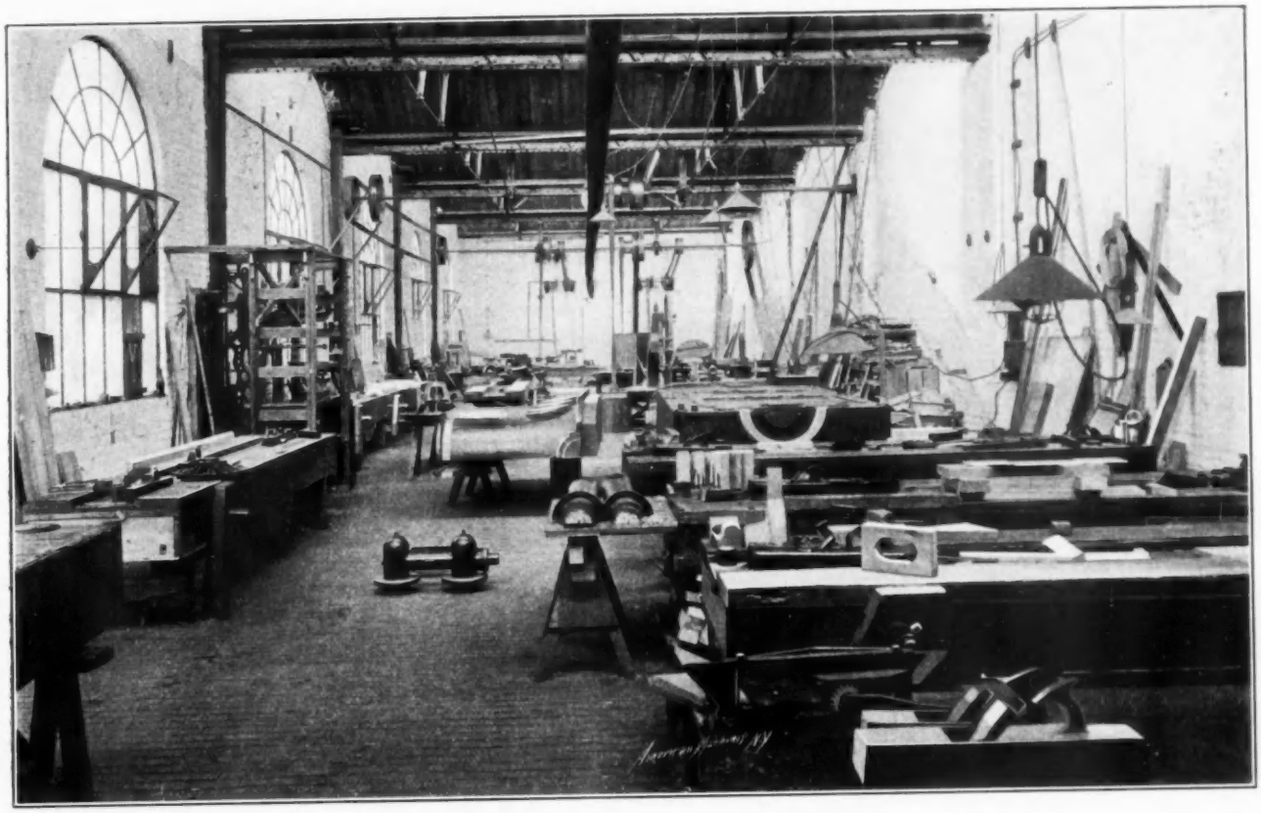


FIG. 8. PATTERN SHOP.

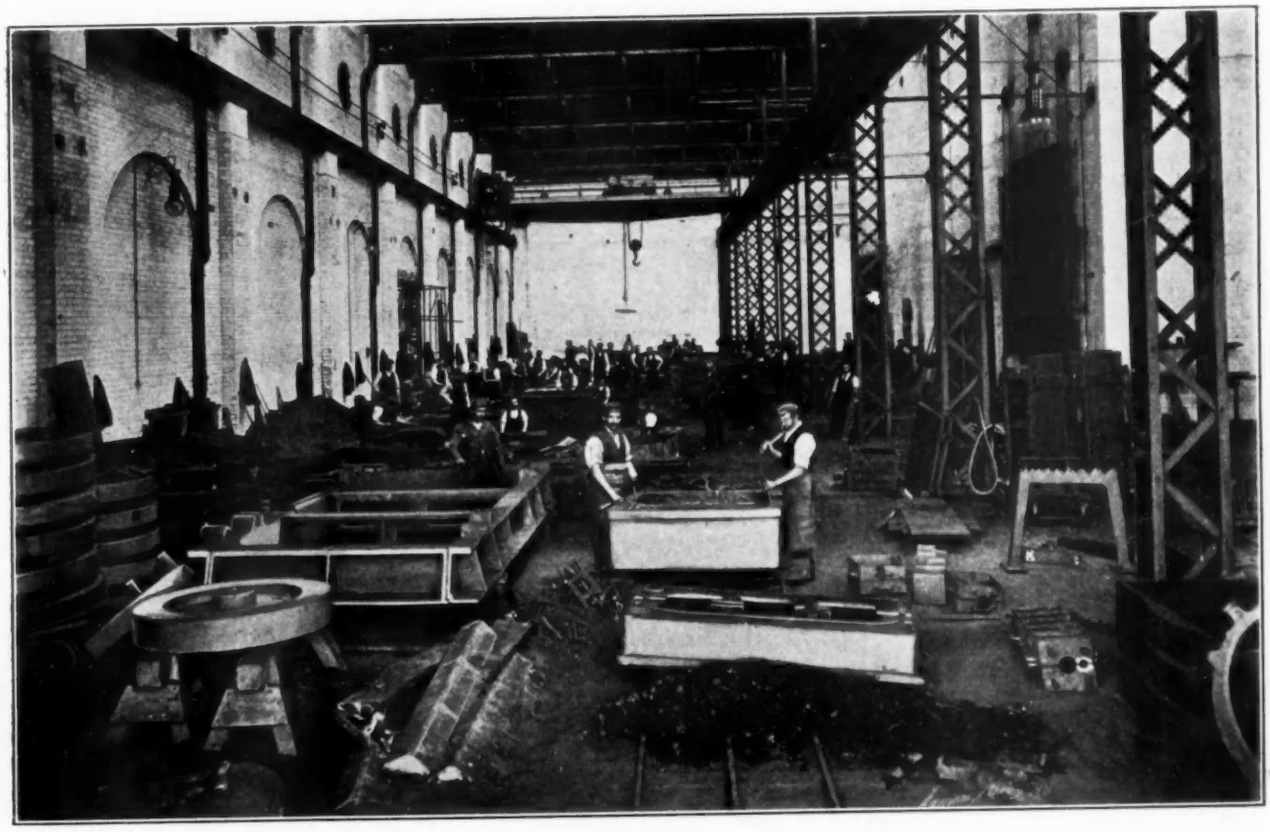


FIG. 9. VIEW IN FOUNDRY.

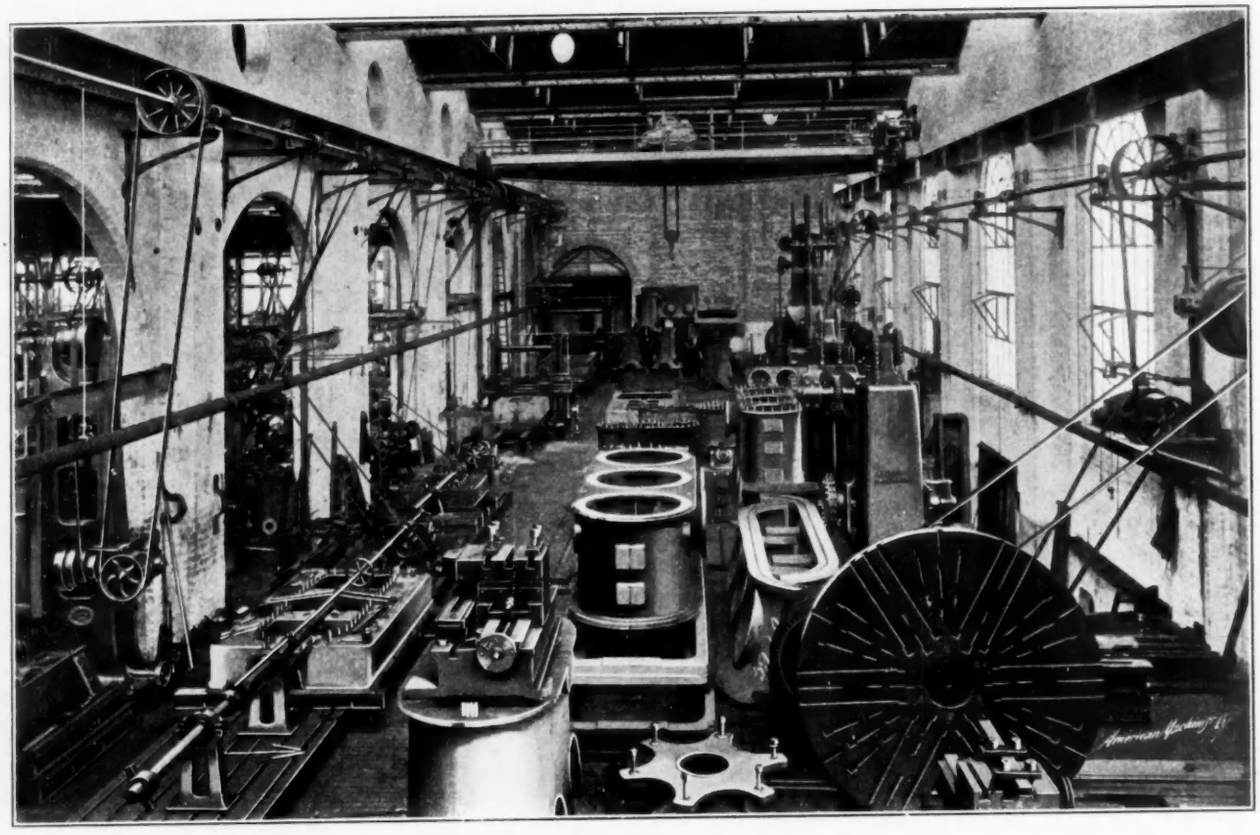


FIG. 10. VIEW IN MACHINE SHOP, BAY NO. 9.

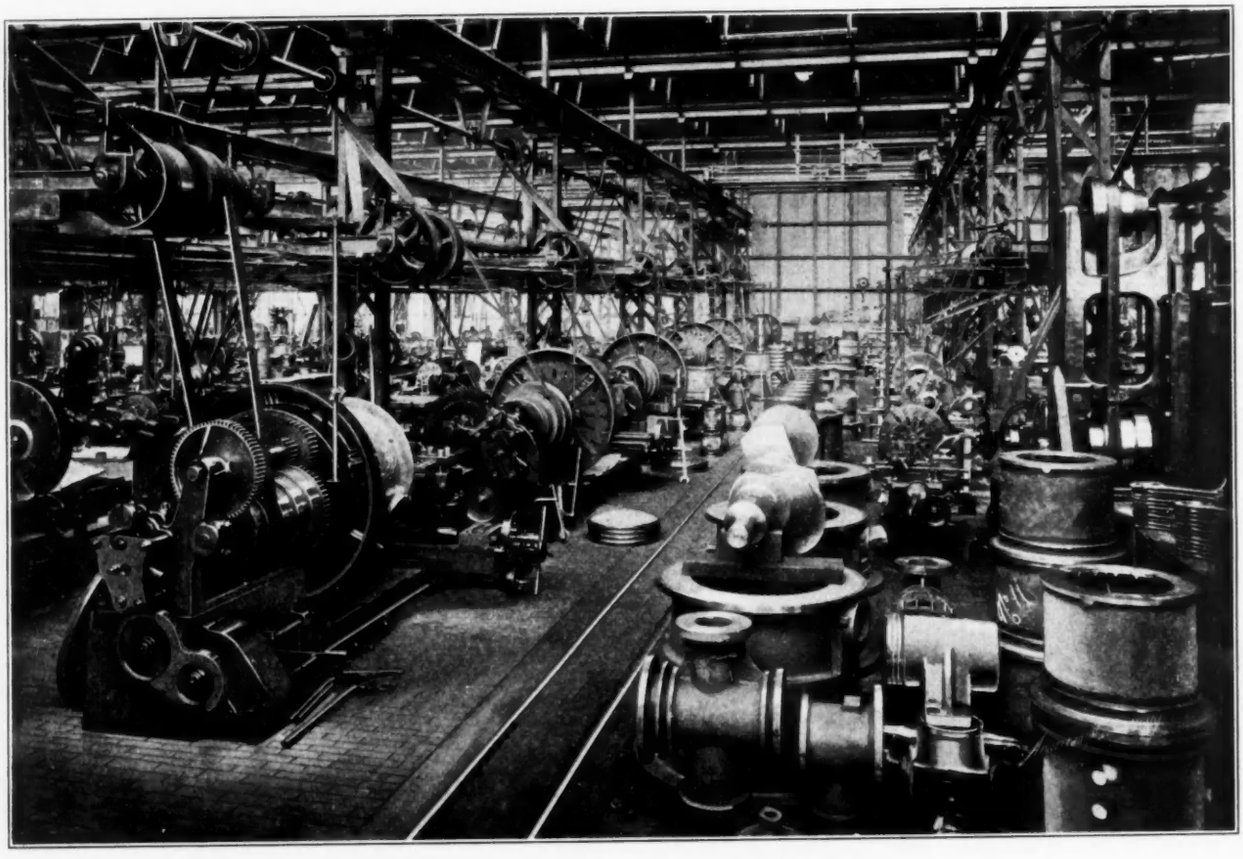


FIG. 11. VIEW IN MACHINE SHOP, BAY NO. 7.

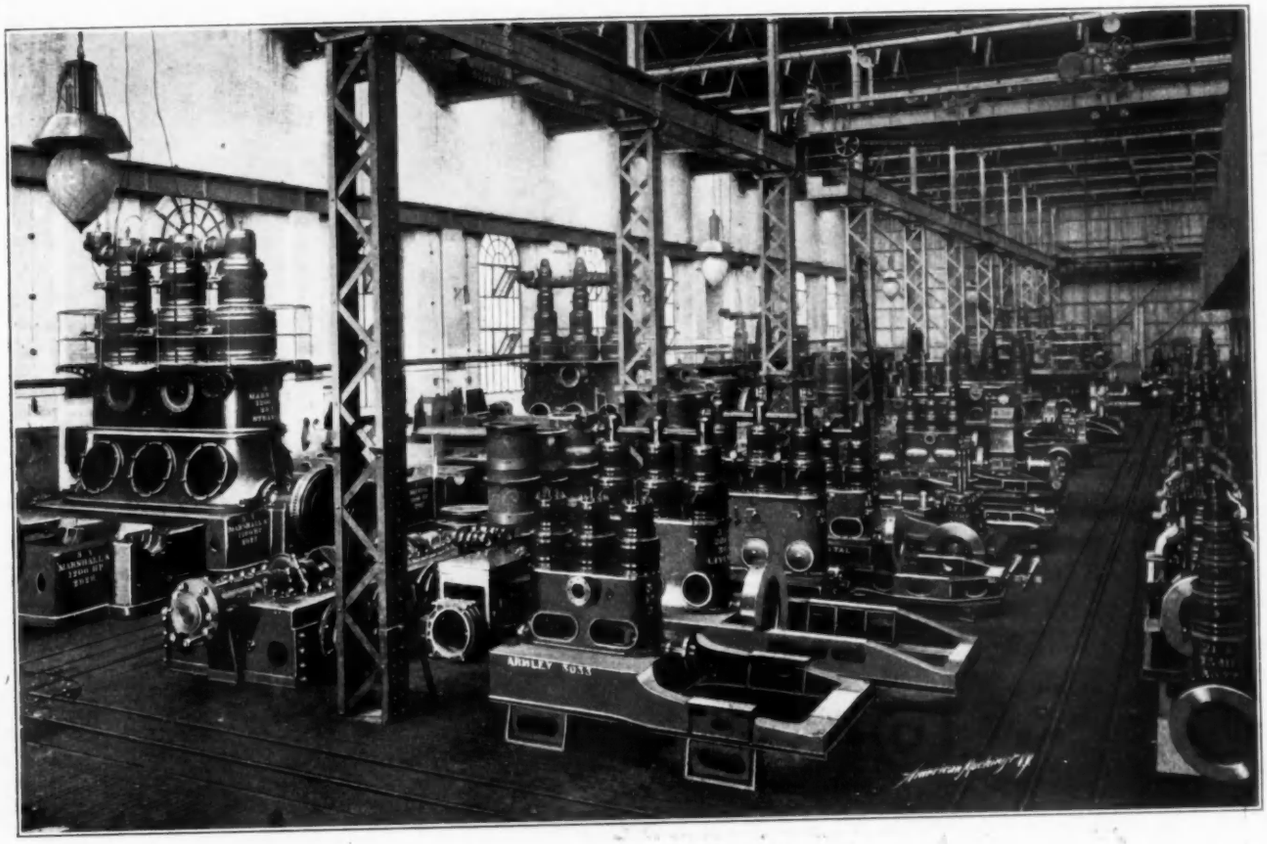


FIG. 12. VIEW IN ERECTING SHOPS.

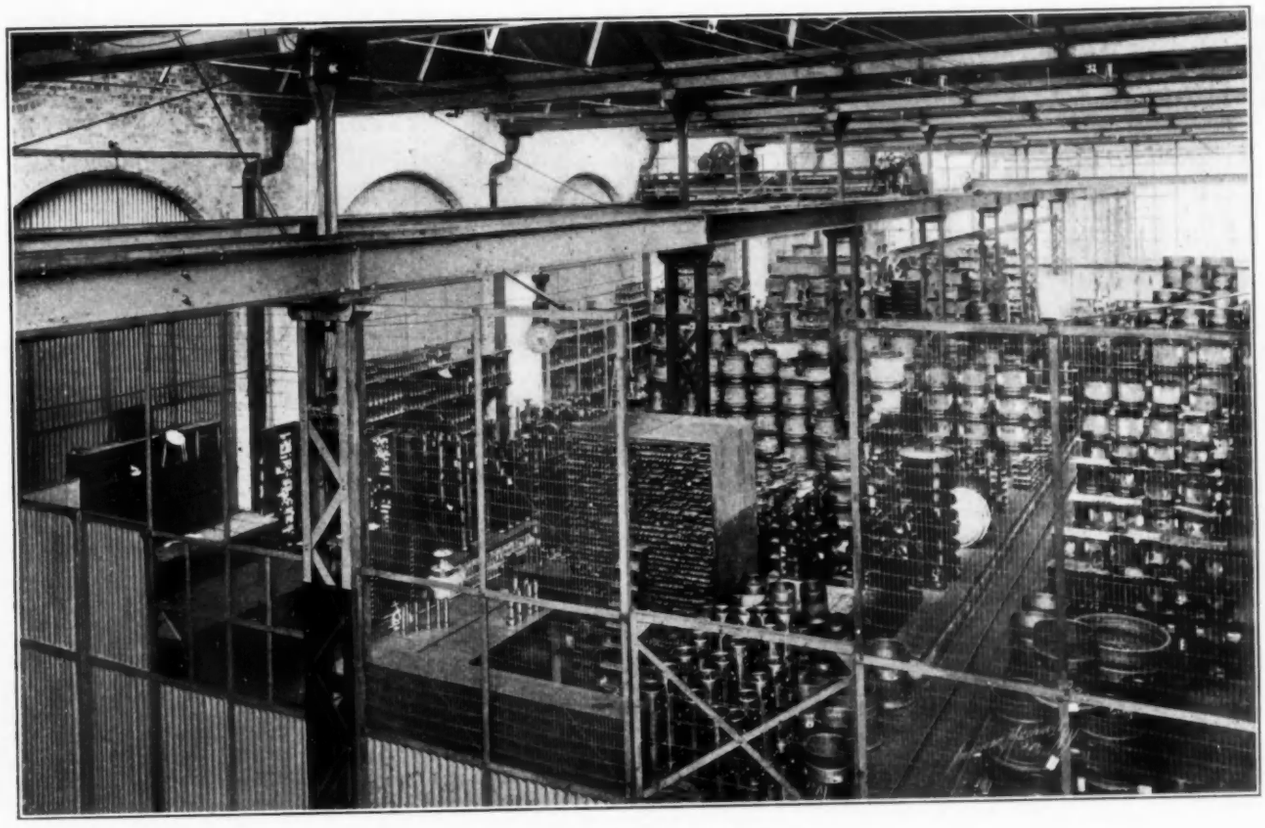


FIG. 13. MANUFACTURED STORES.

Echoes from the Oil Country.

PERPETUAL MOTION.

It is not always best to ask too many questions, especially when a little quiet thinking will make it unnecessary; but after one has made mysterious wheels and levers and what-is-its, one at a time for the same man, and gradually gets to a certain degree of familiarity with him, in spite of his evident reserve and desire for secrecy, the time is apt to come when he

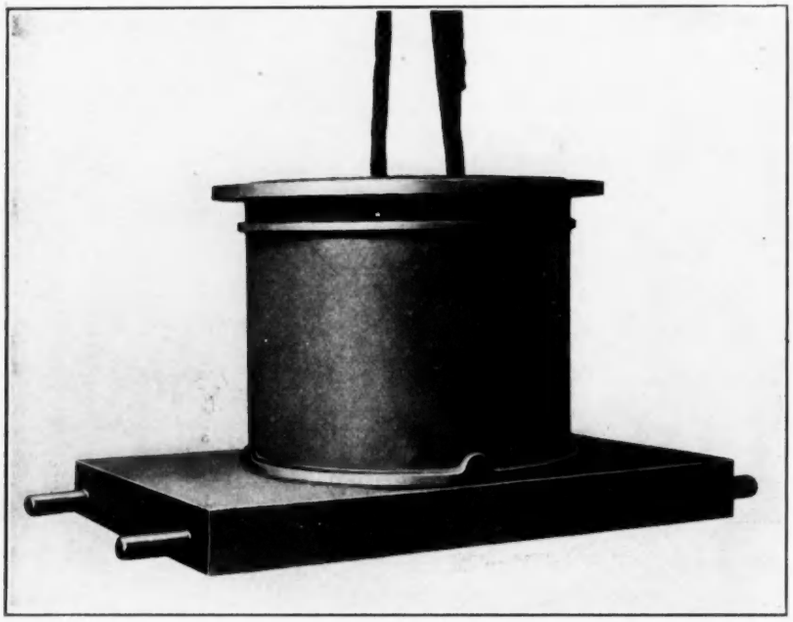


FIG. 14. CYLINDER AND SURFACE PLATE SUSPENDED FROM CRANE BY ATTACHMENT TO DISK GAGE FITTED FREELY IN CYLINDER.

wonders what the wonderful invention is, and he may so far forget himself as to ask.

This at least was my case, and when I abruptly asked, "What is this thing, anyway?" the gentleman (for he was one) smiled a little, looked me over quietly and then replied, "I suppose you will not think much of it; you mechanics hang so to things that mean dollars only, but I don't know as I mind telling you. I guess you know enough to not talk too much, and I suppose you would call it a perpetual-motion machine. Some day I will let you see it. I would rather not explain it just yet, but it is all right. I have it all figured out." I did some more work for him, but always with regret, as I believed he was following a delusion.

I have never seen the apparatus, whatever it was, nor heard of its being finished, and I regard the incident as another illustration of the fact that a man may be well educated in one direction and very ignorant in another. Because you find a man away up in a certain calling does not prove him to be a safe guide in some other kind of business, nor, on the other hand, is it safe to assume that because a man is grossly ignorant in one line he is in all.

That was my first practical experience with perpetual-motion machines, but not my last; and one thing has surprised me: Take a sketch of the first mechanical device that you can think of that is clearly a perpetual motion, take it to every machinist you know, and I venture to say that over one-half of them will fall in with the idea and say it will work. Take some of the best known principles of mechanics and disguise them a little and they will not be recognized. A man had a spring on a hillside. On the other side, and lower than the spring, was a brick yard where he wished to use the water. The hill was somewhere about 80 feet higher than the spring, but that was the shortest way, by several hundred feet, to the brick yard. On inquiry, he learned from several mechanics that he could syphon the water over; but would have to use a foot valve at the spring and a valve at the brick yard, and fill his pipe solid full, to get started. The matter was mentioned in a shop employing about fifteen or eighteen mechanics, and only two maintained that it could not be done. The syphon was actually tried, but the pipe was laid around the hill before the water from the spring was used very largely at the brick yard. Some of the men contended that if he had made several syphons, and made one take hold where the other left off, he would have been all right.

I found a chap once explaining to our men the virtues of a wonderful crank he had, that was without a dead center. The reins were bent so that they curved out beyond the center line. To understand my meaning, think of a semi-circle with the pin at one side, the arms at the other and the semi-circumference forming the reins or bell, and you have the idea. He was illustrating the matter by hitching a string to the pin, holding the arms in his hands, and letting the men pull on the string. If you ever tried water smelling with a forked branch when a boy, you don't need to be told how accurate that test was. What surprised me was that Sammy was the only one that jumped on to the idea, and the others were not numbskulls either. That bent part simply misled them, and they did not think back to first principles.

One of our boys came to me with a rude sketch of a machine he had gotten quite excited over, and asked about it. A little thought showed it to be a perpetual motion, if it was anything. I was not surprised at the boy for being misled.

An experienced draftsman, a technical graduate, was showing me the drawings of an extensive machine. I asked him how much less the force was at one point

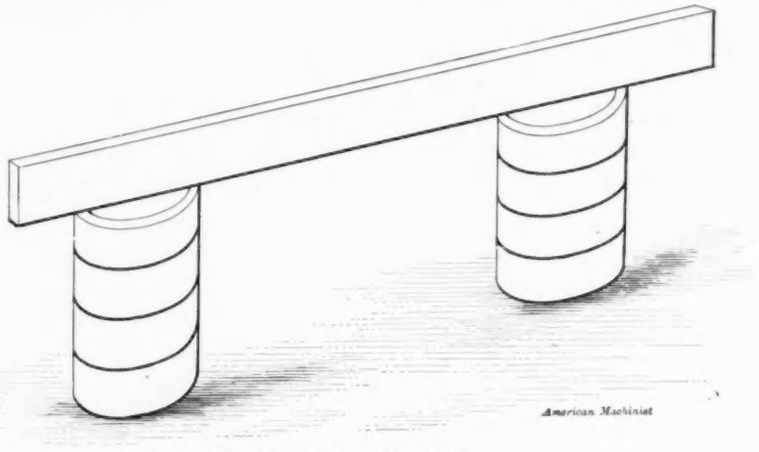
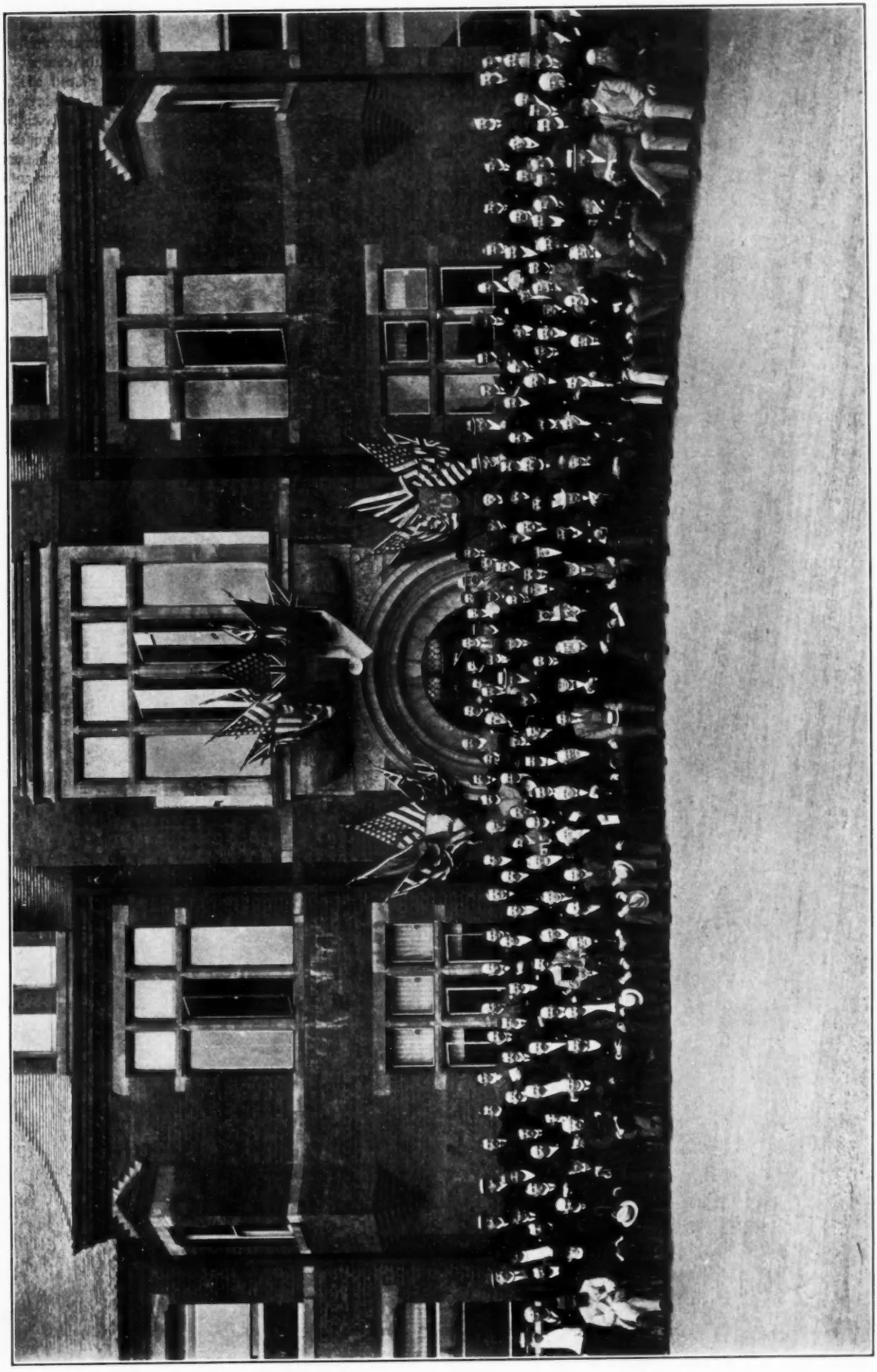


FIG. 15. A TEST OF RINGS.

I designated than at another, where it first came to the machine. He said it might not be less; I said it surely was. He smiled indulgently at me and said of course I might have that opinion, and might guess right; but it would have to be calculated to tell.

When asked at which point it had the most motion he promptly pointed to the place where I expected less pressure, and he then went to figuring angles and sines and leverages in a way far beyond my depths. I was surprised at him.

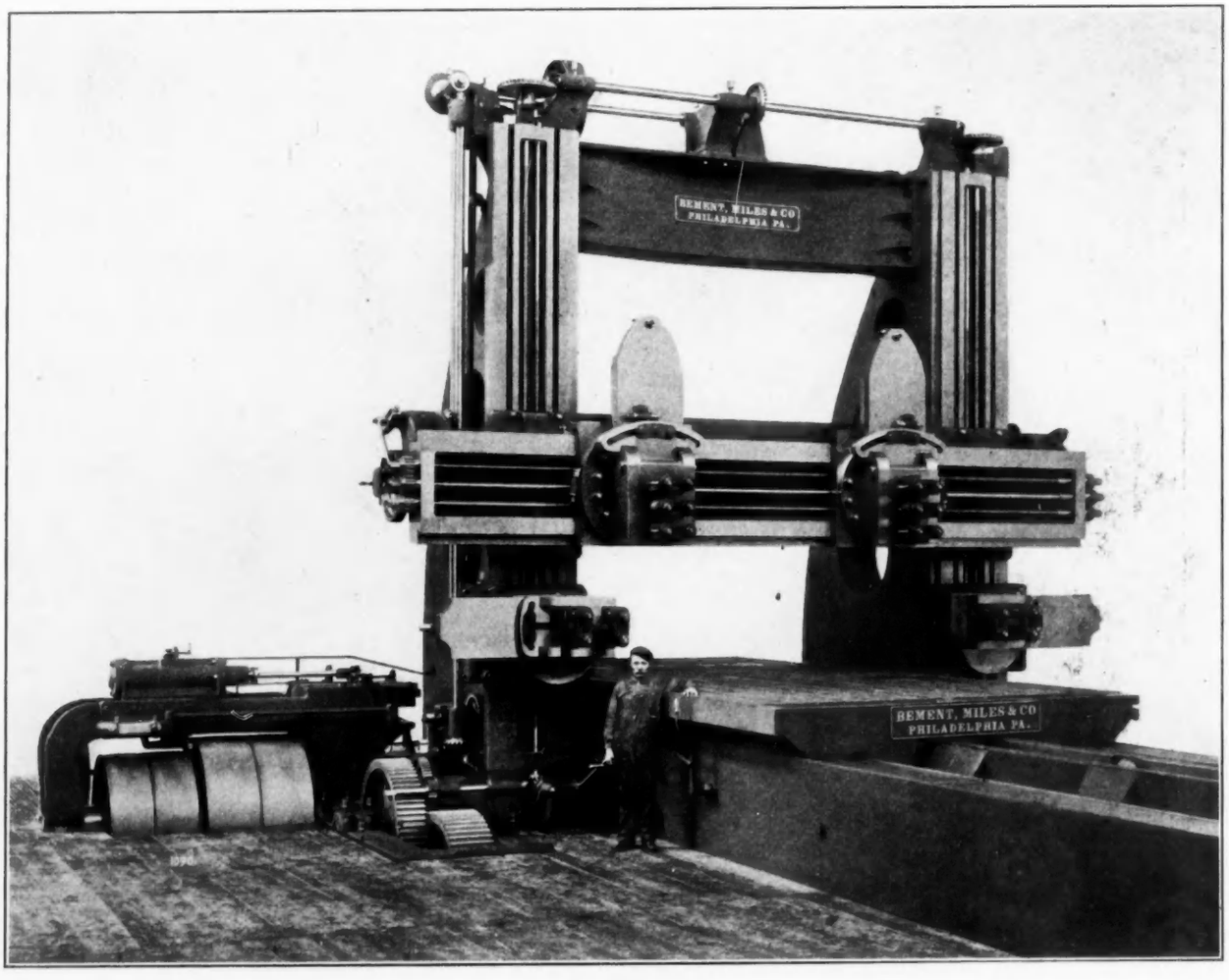


MEMBERS OF THE INSTITUTION OF MECHANICAL ENGINEERS AND OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, ON A VISIT TO THE WILLANS & ROBINSON SHOPS, JUNE 29, 1900.

I gave the boy a rule and illustration that will be of use to him; I am afraid the other one knows too much to use it. If I balance a lever and hang a weight on each end, so that one end goes down and the other one up, I can always be sure of one thing. If I multiply the distance the weight goes up by that weight; the result will never be more than the result found by multiplying the weight that goes down by the distance it goes down, nor quite as much. If it were more, that weight would go down instead of the other. If they were equal, there would be no motion. The rule, then, is simply: Weight × motion of the mover = weight × motion of moved + something. This something is whatever friction takes up in the parts between the two points.

Of course everyone knows all this, and I should know better than to try to bring out such primary matter here; yet somehow when that lever stretches out into belts and cogs and such, every once in a while someone forgets it is practically a lever still, or where he cannot see the connecting parts he gets a little rattled, and perhaps sees advantages in claims when there are none.

The man that was willing to move the world if someone would be so kind as to furnish a place for him to rest his lever on, did not intend to move it 4 inches with one stroke of his arm. The man that told me how much easier his bicycle ran after he had bent cranks put on, and how he could climb hills he had always stuck on before, and go so much faster because his feet did not have to go so far in getting around, may have been honest enough in his belief. He would be a good patient for a faith cure. I wondered why he didn't carry the idea farther and get cranks made like scrolls and get so he could ride up telegraph poles or perhaps even fly. Just think of a crank 10 feet long that you only had to wiggle your toes a little to get the full benefit of. W. OSBORNE.



A POWERFUL PLANER.

A Powerful Planer.

The accompanying engraving is of a planer which we consider a notable machine. It will plane 12 feet 3 inches wide by 12 feet 3 inches high by 35 feet in length. The table is 11 feet wide, resting on three flat slides 13 inches wide, with oil pockets and rollers for lubrication. The two outer slides simply take the weight. The center slide has vertical bearing surfaces for taking up the side thrust, and extending on one side of this center bearing for its entire length is placed a shoe adjustable horizontally for taking up the side wear. The table is driven by two forged steel racks cut from the solid, 15 inches face 3.14 inches pitch, through connected gearing from pulleys 50 inches in diameter for a 15-inch belt. The pulleys for the return motion are 60 inches in diameter for 18½-inch belt. The driving gears and shafts are all made of steel cut from the solid. On account of the great width of belt used for driving this machine it was found impossible to shift in the usual manner from the tight to the loose pulleys, so that a compressed air cylinder is connected with the shifters, controlled by a valve operated from the table. This device is at this writing untried in practice, and so it is not positively known that it will be entirely satisfactory, but it is believed it will be.

The cross-slide has a vertical face 46 inches wide and is raised and lowered on the housings by power. The heads on the cross-slide are made one-sided and

have power feeds in all directions independently, controlled both as to amount and direction from the end of the cross-slide. On account of the great weight of the various parts of the heads the traversing screws are geared up for facility in handling, and ball bearings are inserted at the various thrusts to lessen friction. The tool aprons have positive automatic tool lifters. The housings are of box form and most massive construction, 34 inches wide across their front faces and 9 feet deep at the base. Two side heads are furnished, counterweighted, and with power vertical feed, in and out hand adjustment and swivel. They have quick power vertical traverse. As this machine is intended for planing armor plate with wet cuts a system of drainage was arranged to keep the lubricant off of the gears and prevent its reaching the floor. The machine to plane 35 feet in length weighs 600,000 pounds. It has been built by Bement, Miles & Co., of Philadelphia, for the Bethlehem Steel Company.

Radial Drilling and Tapping Machine.

The accompanying illustration shows a double-spindle drilling and tapping machine which has just been brought out by the Newton Machine Tool Works, of Twenty-fourth and Vine streets, Philadelphia.

The drilling and tapping spindles are sufficiently indicated by the drill and tap in position—the latter being carried by a friction tapping head. While the drilling is being done the tapping spindle remains idle. A hand lever will be seen in the head at the right of the vertical hand feed shaft. In the position shown, which is the middle position, the observer is looking nearly directly at the end of the lever. Depressing this lever starts the tapping spindle at tapping speed, and raising it reverses the spindle at a higher backing out speed.

The special feature of the machine is the provision for quick adjustment of the tap to bring it in line with the hole after the drilling is finished. At the left side of the head is a hand wheel, behind which and attached to it is an adjustable indicating finger which registers with a mark on the end of a pin below the wheel. While the drilling is being done the operator adjusts the finger to the mark and clamps it there. Then, after withdrawing the drill, the hand wheel is given one exact turn, as shown by the finger. The proportions of the gearing connected to the hand wheel are such that this movement slides the head on the arm the exact distance between the spindle centers and thus brings the tap in line with the hole.

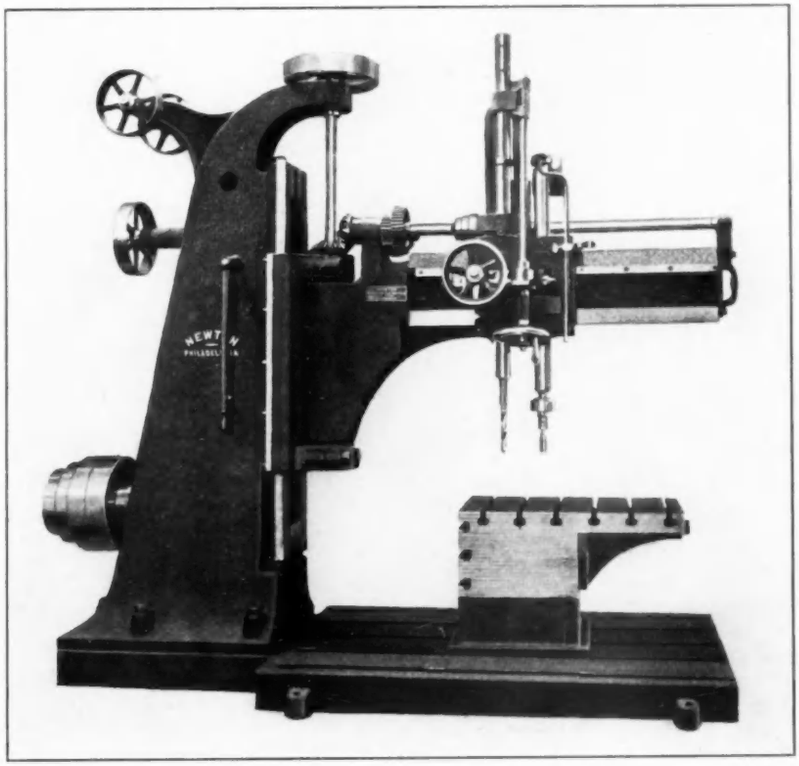
In the case of a piece containing many holes, like the flange of an engine cylinder, the arm is swung and the head adjusted for each hole, the tapping of each being done before the next is drilled.

Valve Gear for High Pressure Hydraulic Elevators.

BY WM. BAXTER, JR.

As is well known, in all types of hydraulic machinery the lower the pressure the easier it is to make the apparatus operate in a satisfactory manner; nevertheless, there are conditions under which high pressure is more desirable, if not actually necessary, and in such cases the engineer is called upon to produce designs that will surmount the difficulties. The main objection to high pressure is that it renders more difficult the prevention of leakage through the pistons or plungers and the valves.

In hydraulic elevators of large capacity intended for use in office buildings, where room is valuable, the high-pressure system is decidedly advantageous, as it not only reduces the size of the elevator cylinder, but also the size of the piping. A low-pressure elevator capable of lifting a load of about 1 ton, at a velocity of 300 to 400 feet per minute, will require supply pipes anywhere from 5 to 6 inches diameter, and a considerable amount of space is required to accommodate pipes of such size, especially when they turn corners. If a high pressure is used, the diameter of the pipes can be reduced more than the diameter of the cylinder, because, in consequence of the high pressure, a greater loss can be sustained in pipe friction without reducing the net efficiency of the system. For example, if the pressure is 100 pounds and the loss due to pipe friction is 50 pounds, the available pressure in the cylinder is 50 pounds, so that the actual loss is 50 per cent. Now, if the pressure is 800 pounds and the pipe loss only 50, the actual loss is a trifle over 6 per cent.; and to make the pipe friction loss the same as with the low pressure, it would have to be 400 pounds. Thus it will be seen that as a greater loss of pressure can be permitted with a high-pressure system, the pipes can be reduced in diameter more than the cylinder. In high-pressure elevators the pressure used ranges from about 700 to 1,000 pounds, and the supply pipes are about 1 to 1½ inches in diameter. The cylinders are of the plunger type, are placed in a vertical position, and in almost every case are inverted, the plunger being forced downward. The object of this arrangement is, to be able to reduce the weight of the plunger so that it will only partially balance the elevator car. With an upright plunger, the weight of the latter must be sufficient to overbalance the car when loaded to its maximum capacity, so that the weight of the plunger may lift the car, while the pressure of the water lifts the plunger and lowers the car.



RADIAL DRILLING AND TAPPING MACHINE.

The valve gear is arranged so that the main valve is moved indirectly, by the action of a small pilot valve, in this respect the principle of operation being the same as that used with the low-pressure machines, which was explained in the article in issue No. 18. The arrangement of valves used with the low-pressure system, however, cannot be employed successfully

with high pressure. The pilot valve cannot very conveniently be made with cup packings; therefore, when subjected to a high pressure the leakage would be considerable, and would represent a noticeable loss. To get around this difficulty, the pilot valve is subject to a much lower pressure, and this pressure is obtained by making the discharge tank tight and maintaining therein a pressure sufficient for the service performed by the pilot valve and the auxiliary piston.

because, in so far as the action of the valves is concerned, it is immaterial whether they are moved by magnets or by a rope sheave; and, furthermore, the magnet system involves more than the simple magnets shown in these drawings.

Returning to Fig. 1, the tube *d* is the main valve, which controls the flow of water to and from the lifting cylinder. This valve is subject to a high pressure. The upper inlet, marked "supply," is connected with the high-pressure tank, and

der. When *d* is brought to the position shown in the engraving the opening between the supply and *R* is closed. When *d* is raised the ports *f* come opposite *R* and then the water in the cylinder can pass through ports *f* and *e* to the discharge outlet. The cored passages *j j* connect with *R* and also with the open spaces surrounding *d* at this point.

The pilot valve is at the end of rod *F* and of the three pipes *a b c* that lead to it, the center one, *b*, runs to the discharge

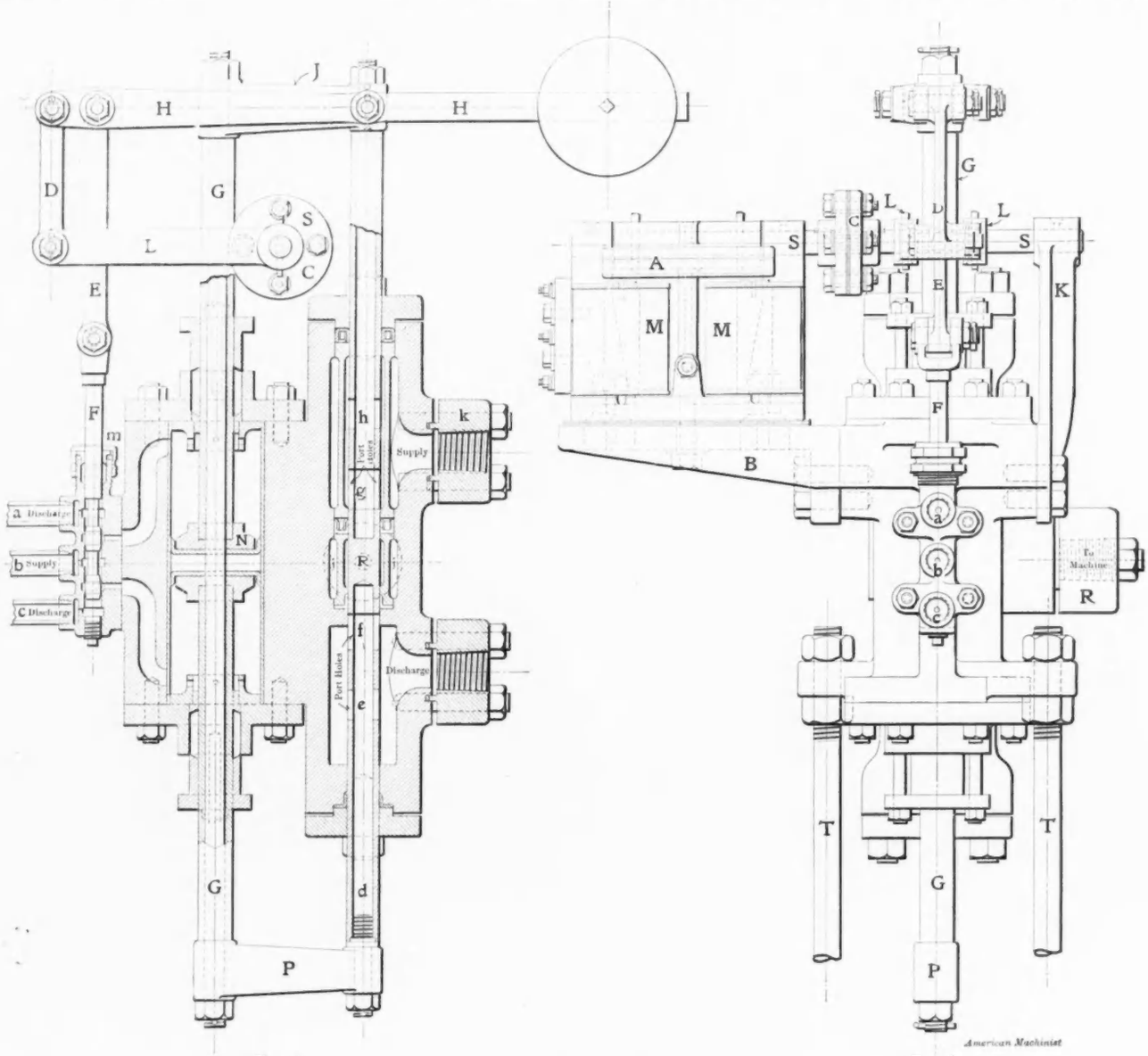


Fig. 1 Fig. 2

HIGH-PRESSURE HYDRAULIC ELEVATOR VALVES.

The general arrangement of the valves for the Otis high-pressure system is illustrated in the engravings. Fig. 1 is a vertical elevation in section of all the valves and connecting levers. Fig. 2 is a vertical elevation at right angles to Fig. 1, as seen from the left-hand side, and shows magnets at *M M* which are used to operate the pilot valve. The operation of the magnets will not be explained in this article,

the outlet *R*, which is better shown in Fig. 2, is connected with the lifting cylinder, while the lower outlet, marked "discharge," is connected with the discharge tank.

When *d* descends, the ports *g* come opposite *R* and the water from the supply inlet passes through ports *h* and *g* to the cylinder, and thus forces the plunger downward, or out of the cylin-

tank with which the discharge outlet of the main valve is connected, and the other two pipes, *a* and *c*, discharge into an open tank, or the sewer. The auxiliary piston *N* operates in the same way as the piston in a steam engine. The shaft *S* is given a small rotary motion either by a rope wheel mounted upon it or by means of electro-magnets. This motion either elevates or depresses the outer end of lever

L, which is connected with lever H through link D. If L moves downward, F is depressed, as it is connected with H by means of E. When F moves downward, water is admitted under N and thus G moves upward, carrying with it d, the two being connected through J and P. As will be seen, the upward movement of G produces an upward movement of F, for the reason that the movement of L is limited to that imparted to it by the rotation of shaft S; therefore, when G moves, the end of L becomes the fulcrum around which H swings. Since the upward movement of G lifts F it acts to close the pilot valve, so that if L is given a slight movement N will only move a short distance before the pilot valve is raised enough to close it. Thus, by graduating the distance through which S is rotated, the distance through which N is moved is controlled. The downward movement of L admits water in the auxiliary valve cylinder above N and thus moves the main valve d in the opposite direction.

The pilot valve is solid and is ground to a tight fit—that is, tight in the sense of leaking, but free so far as movement is concerned. The pressure in the discharge tank may be 30 or 40 pounds; therefore, even if the valve is not perfectly water-tight, the leakage will not represent a serious loss. The piston N is made of large diameter, so that it may be moved with sufficient force, with a low pressure, to operate the main valve d with certainty. If the pilot valve were connected with the high-pressure pipes a very small leakage through it would represent a large loss, and since the amount of water that would pass through the same valve with high pressure would be much greater than with low pressure, it follows that while with the arrangement used the leakage loss can be made trifling it would be difficult to keep it from being large if the pilot valve were subjected to the pressure of the main tank.

Maintaining a pressure in the discharge tank sufficient to operate the auxiliary valve might at a first glance appear to represent a loss, owing to the fact that the lifting cylinder has to work against a back pressure; but when it is remembered that the pump that transfers the water from the discharge to the main tank has to develop a pressure equal to the difference between the two tanks only, it will be seen that there is no loss whatever on account of the pressure in the discharge tank.

The weight on the end of lever H is for the purpose of balancing the opposite end and also the connecting links D and E and the pilot valve. When shaft S is rocked by means of electromagnets a rocking lever or frame is mounted directly upon S and to its ends iron keepers, one of which is shown at A, Fig. 2, are attached. When the magnets on one side are energized that side of the rocker frame is drawn down, so that by shifting the current from one set of magnets to the other either side of the frame can be depressed, and thus the shaft can be rocked in either direction. When S is moved by the rotation of a rope sheave, the latter is not mounted directly upon the shaft, for with such construction the movement of the wheel would be entirely too small. To effect the small movement required for L and permit of a considerable movement of the rope sheave, the latter is arranged to impart motion to L through a link or cam in a manner substantially the same as was shown in the drawing of the low-pressure valve gear in the article in issue No. 18. The rods $T\,T$, in Fig. 2, are feet upon which the apparatus is supported.

Some Features of Shop Practice at the Detroit Works of the Boyer Machine Company.

We group together in this article several features of interest gathered at a recent trip to the Boyer works, of which an illustrated description appeared in our issue No. 10. The first of these is a

VERTICAL GRINDING MACHINE.

A large amount of internal grinding is done in these shops, and this machine was designed and built to do away with the flying of water when a flood of it is used for internal grinding on horizontal machines. The machine is shown in Fig. 1, and it will be seen to have none of the appearance of most "home made" machines. On the contrary, it would be a legitimate object of pride to a tool-building house.

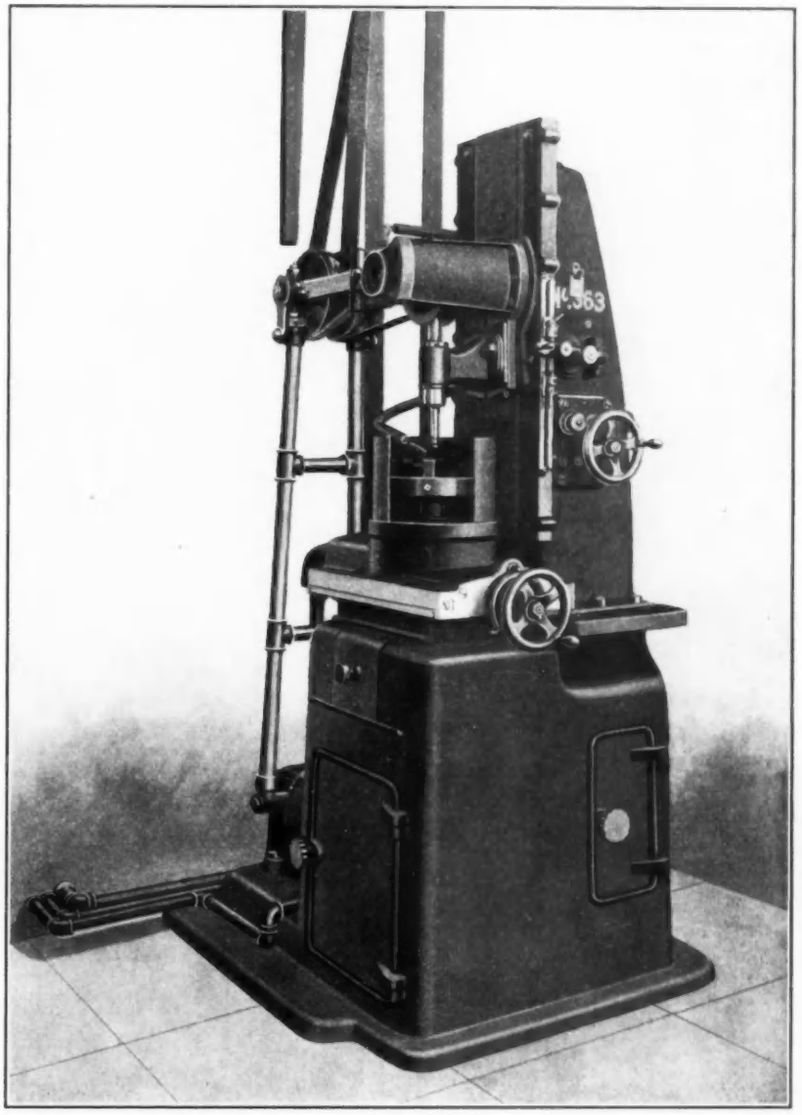


FIG. 1. VERTICAL INTERNAL GRINDING MACHINE.

The work spindle will be seen to come up from below and the emery wheel spindle to descend from above. The upper end of the work spindle is surrounded by a water guard which is open in the picture. This guard is not, however, expected to take care of the bulk of the water which runs away through the hollow work spindle shown in Fig. 2. The regular run of work is held in drawback chucks, which are operated by the head a, which acts

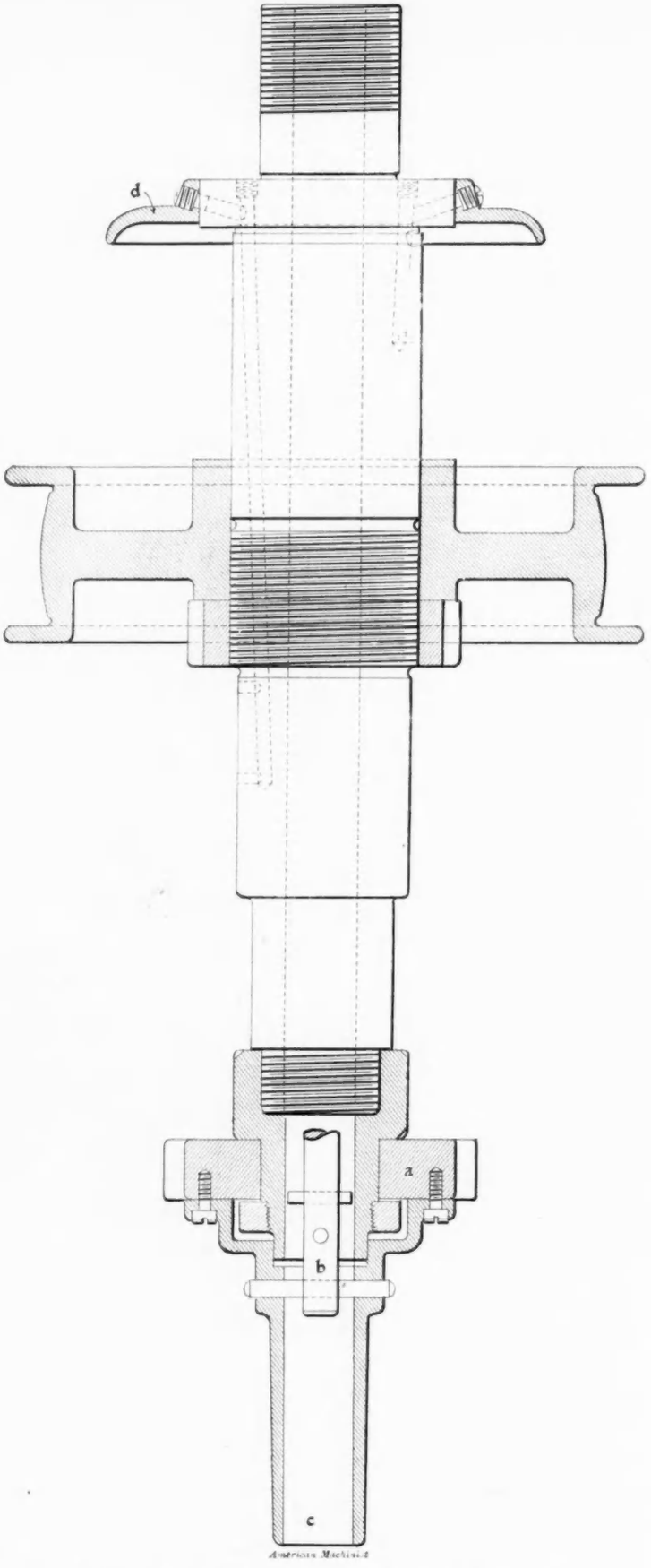


FIG. 2. WORK SPINDLE OF VERTICAL GRINDING MACHINE.

on the rod *b*, extending up through the spindle, a thread at the upper end of this rod acting on the chuck. The chuck sheds the water down through the spindle and it escapes by the nozzle *c*. Any water which splashes over the top is taken care of by the guard shown in Fig. 1, and, with that going down the spindle, is returned to the water return-pipe system shown in our previous article. To prevent this water getting into the spindle bearing a shield *d* is fitted above the bearing and

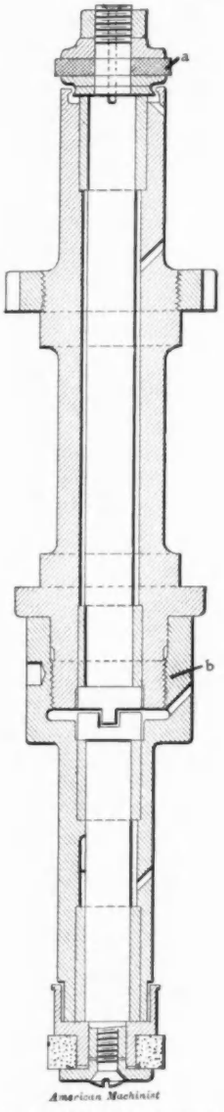


FIG. 3. EMERY WHEEL SPINDLE.

by its shape and by centrifugal force keeps the water from the bearing.

The very high speed of the emery wheel necessary for internal grinding is obtained without belting to the spindle in the very neat way shown in Figs. 1 and 3. Referring to Fig. 1, the belt from the countershaft drives a pulley which is carried by a swinging frame of pipe supported near the floor. A second swinging frame connects the top of the first frame with the spindle driving head. Pulleys each side of the one driven from the countershaft drive two disks in the spindle driving

head, one disk being driven by an open and the other by a crossed belt. These disks embrace and drive a fiber washer *a* on the upper end of the emery wheel spindle, of which the construction is shown in Fig. 3. The support for the bearing next

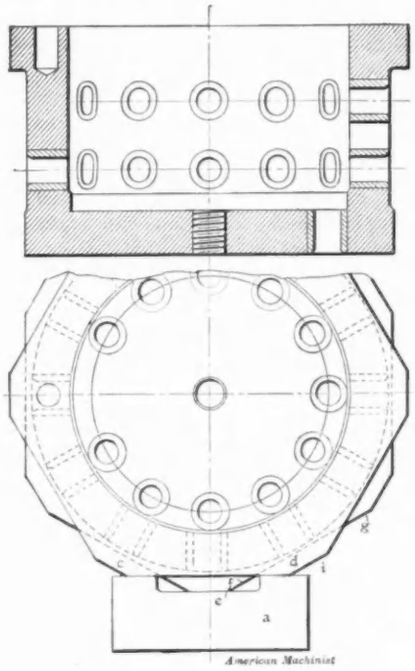


FIG. 4. A STABLE JIG.

the wheel and the manner in which the wheels are changed by separating the parts at *b* will be apparent from this illustration. By adjusting the spindle vertically and thus changing the radial position of the fiber washer with respect to the driving disks, the speed of the wheel may be readily changed within wide limits.

DRILL JIG.

Several cylindrical shells of different sizes made at these works require numerous radial holes—the complete circle being divided into as many as twelve parts by these holes. A jig for these pieces might be made cylindrical in general form, but with twelve flat faces for the jig to stand on for the different holes. Such a jig, however, would be pretty nearly round and would not stand securely on the drill press table. The very neat arrangement of Fig. 4, which has the stability of a jig with six sides, is therefore used.

Each end of the cylindrical body has a flange with six faces—the faces of the two flanges alternating with each other. A trough-shaped piece of cast iron, seen endwise at *a*, lies on the drill press table, and on it lies the jig. In the position shown the face *c d* "indexes" the jig, but the opposite flange *e*, resting in the bottom of the groove of piece *a*, supports the jig at that end. When the jig is turned for the next hole, face *f g* at the opposite end will index it, while flange *i* at the near end will support that end. The jig is turned from hole to hole without thought of the arrangement on the part of the operator, and its stability is obviously much increased by the arrangement.

SCREW MACHINE CHUCK.

Fig. 5 shows a chuck which is much used on hand-operated turret lathes, and of which but little is needed in the way of description. The hole is bored to fit the piece to be chucked, and the split clamping ring grips the chuck on the piece. This chuck is used for accurate work, and on this account is not threaded to the spindle. It is, on the contrary, bolted to a faceplate, and when, after the manner of chucks, it gets out of true, it is easily brought back again. Each chuck is provided with a hardened and ground test plug, shown in the upper part of the illustration. This plug is an accurate fit in the chuck, and when gripped in the chuck, the latter being in the lathe, it enables the chuck to be tested for truth by a multiplying indicator. If out of true, it is soon corrected by some careful work with a soft hammer. The lump opposite the bolt lugs is to balance the chuck.

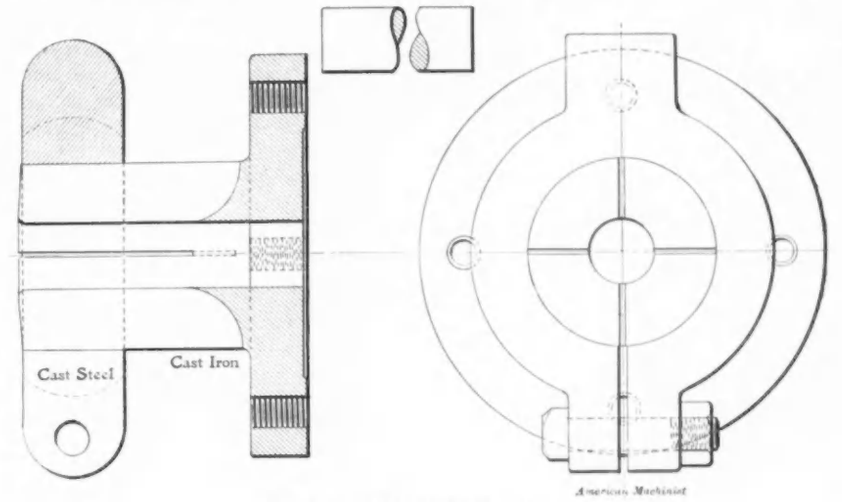


FIG. 5. SCREW MACHINE CHUCK.

BOILER SUSPENSION.

Most of the above ideas are, we believe, due to Mr. Doughty, the superintendent. Fig. 6 shows an idea due to S. E. Freeman, of St. Louis, in connection with the power plant. It is a plan for so hanging the boilers as to relieve them of all undue strains growing out of the manner of support or to expansion and contraction, and to render their support independent of the brick work—the brick setting being a furnace and flue wall only.

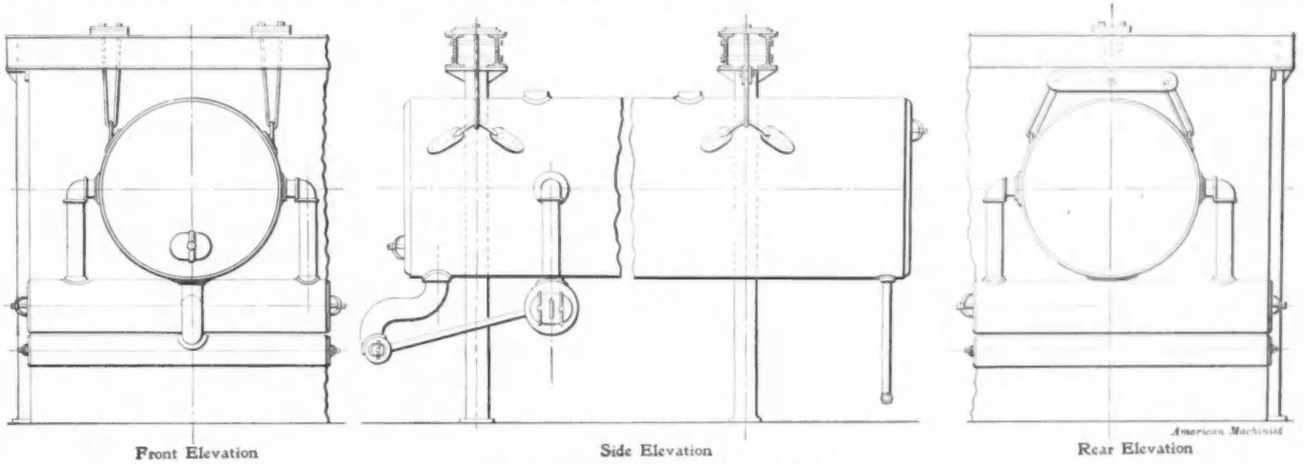


FIG. 6. METHOD OF HANGING BOILERS.

The boilers, of which there are two, are of the return tubular pattern with Hawley down-draft furnaces. The front and rear elevations show that there are four points of suspension, so far as the boiler shell is concerned, but three points when the supports are considered. The boilers are hung from overhead girders, which are supported by columns outside the brick work.

INSPECTION OF WORK.

All parts made are regularly inspected by a duly appointed inspector, but it was found here, as it has been found elsewhere, that inspection of a lot of finished parts sometimes becomes a case of locking the stable door after the horse has been stolen. The comfort that can be obtained from scrapping a lot of finished but defective parts is of the chilly sort, and Mr. Doughty has devised a plan for preventing its necessity.

Each machine tool is given a numbered check, which ordinarily hangs on a hook attached to the machine. One of them will be seen hanging to the upright of the grinding machine, Fig. 1. On the inspector's bench is a post with hooks. After a machine has been set up for a new job, and before much work has been done, the check belonging to the machine is hung on the post on the inspector's bench. The presence of the check informs the inspector that the machine is beginning to turn out a new lot of parts, and he immediately goes to the machine to determine if it is properly adjusted and if the parts being made are correct. This does not take the place of the detailed inspection of the finished pieces, but is intended to prevent the making of a lot of defective parts through incorrect setting of the machine because of errors in reading the drawings or any other cause. It fixes responsibility on the inspector and insures his attention to each job at a time when he can prevent errors, instead of, as usual, merely detecting them after they have been made.

Letters from Practical Men

More Pump Troubles.

Editor American Machinist:

The "chief" in the new power-house looked worried, said he didn't like to be beaten, but that electric pump was too much for him. "What's the matter? Why, it won't lift the water." "Well," I said, "it worked all right when it was set up, and there has been nothing changed." "Not a thing," he replied, "except that automatic high and low water starting device, and that hasn't got the float connected yet, so that I have to trip it by hand. The pump works all right; it's up to speed" (750 revolutions per minute) "but it won't pump any water."

The pump was a plain centrifugal, arranged like the accompanying sketch, Fig. 1, to take care of any water which collected in the pit or sump. The blades were about 24 inches diameter; the shaft was vertical, coming up through the engine-room floor with an electric motor direct connected at the top. A float connected to the automatic starting box was designed to start the pump when the water reached high-water level and stop it at low-water level.

At the time of which we are speaking, everything was complete, except the float, which had not been connected. When the water was at its lowest point it was less than 4 feet from the pump, and at other times the pump would be submerged, and the discharge was only 12 feet above the pump. There were some drips connected into the pipe above the tee, which of course would flow out of the discharge by gravity if the gate valve was closed when the pump was not in use.

Naturally the first question I asked was

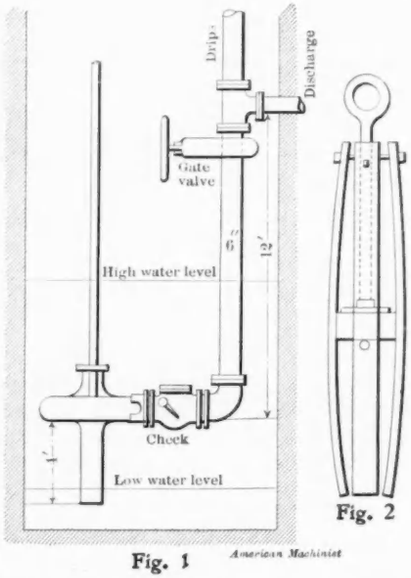


Fig. 1

Fig. 2

TWO PUMP TROUBLES AND THEIR REMEDIES.

whether he was sure the valve was open and whether the disk might not be off the stem, even if it was a gate. He assured me that the valve was all right, except that it leaked a little. "The trouble is in that check," he said. "When I took the lid off I found the pipe full of water. There are 12 feet of water on that check, and it is a heavy check anyway; it ought never to have been put down there; it ought to have been up where the tee is. The way it is now, that gate leaks a little, and when the pump starts it has to lift that check with 12 feet of water on it, and it won't do it." I suggested that it did do it before. "Yes, it did; but it won't do it now. Why, it won't even lift the check when there is no water on top of it. I took the cap off the check and started the pump, and it wouldn't lift the check, until Jim went down there and touched it with a stick, and he nearly got drowned before he got out of the well. That flap in that check weighs 25 or 30 pounds. I took it out once and put the lid on and pumped the well out all right, but it won't do to leave that check out, and anyhow it pumped before with that check in all right; it ought to do it again." When I suggested that the check must stick, he knew it couldn't; it was a swinging check, perfectly free, with a good seat. I insisted that there must be something wrong; it ought to go. "Well," he said, "I have spent the whole day trying to make it go, and I'm stuck. If you can tell me what is the matter, I'll be glad to have you do it."

I thought very hard for a few seconds, and suddenly remembered that I had to see a man right away, and told the chief I would drop in again.

It would be interesting to have our readers all stop here and tell us why the pump wouldn't pump. The collection of answers would no doubt be interesting, and no doubt many would answer correctly.

When I saw the chief again, he had his usual happy look. He just walked over to the pit and pointed down to the pump. "Do you see that little pipe? That fixed the whole business." He had tapped a ¼-inch hole in the pump discharge close to the check and stuck a length of pipe into it. "Now, when I start the pump the air just gives a couple of puffs out of that pipe and away she goes. You see, before when we pumped down to the bottom of the suction, of course the air came in and emptied the pump, and when the well filled up there was the pump full of air and that check held down with 12 feet of water above it. Anybody would know it wouldn't work that way."

A customer once came in and said he had drilled two wells, about 20 feet apart, one 200 feet deep and the other 350, both cased with 8-inch pipe. He wanted a pump that would pump both those wells at once. "Just put up a couple of uprights and hang a walking beam over these two wells with a sucker rod on each end, hitch an engine on it somewhere and you've got the whole thing." We objected a little on one or two points, but he showed us how easy it was and he always paid his bills promptly, so we went ahead to build it.

We were so thoroughly converted by this time that we didn't spend much time figuring strains or making pictures, just got a stick that looked about right for a walking beam, took two pieces of 6-inch brass tubing, 8 feet long for pump barrels, made a valve to go on the bottom, screwed 100 feet of 6-inch iron pipe on each one and hung them from our frame on the wells (the water stood in the wells within 50 feet of the top), put in suckers and rods, took an engine our customer had, and before long were ready to start. That pump had 6-foot stroke, and when that walking beam began to move it looked as imposing as the Centennial Corliss engine, and it ran fine for about fifteen minutes. Then something broke; I don't re-

member what, because almost everything about it broke during the next few weeks; but after we had put on a heavier engine and a new walking beam, and changed the sucker rods so they wouldn't unscrew, and a few more things, it started off fine and ran a whole week without a hitch, and we had just told the bookkeeper to figure up how much we had lost on that contract, when they telephoned in that one side didn't pump. I inwardly vowed that the next time I screwed those sucker rods together, they would stay, or I would go out of the pump business. But it wasn't the sucker rods this time; we pulled them all up and found the sucker on the end all right. The next thing was to pull up the 6-inch pipe, taking off a length at a time until the end came out of the well—without the pump barrel. The men all looked at me, and I looked down the hole, and remembered that that well was 350 feet deep. It was too much. I sat down on a block and tried to think. If I had been raised in the oil country it would have been different; but I had never seen an oil well or a fishing tool, and there was that piece of smooth brass tubing down in the bottom of that hole. We went over to the smith shop nearby and made a rig like Fig. 2. We found an old wagon tire that had the corners worn off. We took four pieces, slightly bent, and bolted them loosely together at the top, like the staves in a barrel. In the center we put a 4-inch pipe coupling, into which we screwed a plug, and this we tapped for a 1-inch eye, to which we fastened the rope. We let this down, and on bringing it up found where it had rubbed on the brass, showing that it had expanded before it entered the pipe. We then put a pin at A and tried it again. We got it, and when that pipe emerged from the top of the well, we thought it was the prettiest fish we had ever seen landed. I remember it was about 2 P. M. when we found that we had lost that pump barrel, and we had it out of the well before 6; so that it wasn't bad fishing, considering that we had an improvised hook.

TIMOTHY BROWN.

Axial Inclination of the Calipers.

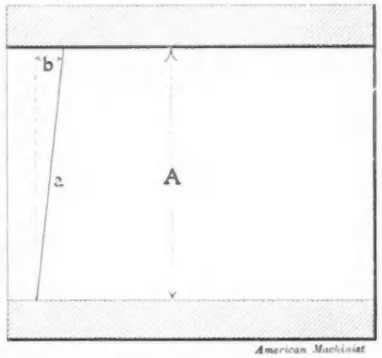
Editor American Machinist:

In reading the contribution by Morris Fulton, on page 497, I was reminded of the reverse way of measuring for shrink or pressed fits. In the case referred to by Mr. Fulton it was desired to produce a hole slightly larger than the piece to go into it, or a piece slightly smaller than the hole. In this case, however, we want a hole somewhat smaller than the piece to be shrunk or pressed into it.

A similar plan of measuring can be employed for this service, and a table giving the tightness can be computed. The sketch will serve to make my meaning clear. This distance *A* is the diameter of a hole and line *a* is the length of a gage the exact size of the piece to be pressed or shrunk into the hole. The distance *b* is the amount the gage lacks of assuming a position square or at a right angle to the axis of the hole.

Very close results can be obtained by this method. I recall once boring holes in a lot of crank webs into which the shafts and the pins were pressed. The pressure determined upon in this case was 40 tons and none of the fits actually required more than 42 tons, while few, if any, went as low as 38 tons, and I am half inclined to think that there was difference enough in the metal to cause at least a part of this difference in the force required to press these pieces home. NICK L. STEEL.

[It is an easy matter to make a table as above suggested. It is only necessary to find the different lengths for the hypothenuse *a* for the right-angle triangle of which *A* is the constant base and *b* the perpendicular, taking *b* at different lengths from ⅛ inch to 2 inches. Assuming the



MEASURING BY INCLINING THE CALIPERS LENGTHWISE OF THE WORK.

diameter to be 12 inches, as in Mr. Fulton's table, then the lengths indicated for different inclinations in the direction of the axis will be as given below.—Ed.]

⅛ in...	12.00065	⅞ in...	12.0318
¼ in...	12.0026	1 in...	12.04159
⅜ in...	12.0058	1¼ in...	12.0649
½ in...	12.0104	1½ in...	12.09338
⅝ in...	12.01626	1¾ in...	12.12689
¾ in...	12.0234	2 in...	12.1655

Points About Making Jigs and a Reamer to be Used With Them.

Editor American Machinist:

I was interested in the article of Mr. Roe, which appeared in your No. 6 and in which he gives some interesting data as to the proper method of procedure as used in "up-to-date" shops in accurately locating the bushing holes in drill-jigs, etc., and the article of Mr. Young appearing in No. 10, in which he seems to take exception to some of the ideas submitted by Mr. Roe (as applied to every-day shops), makes the matter more interesting still.

I fail to appreciate Mr. Young's criticism of the "up-to-date" methods suggested by Mr. Roe, for surely the old tried and true method of using hardened and ground steel buttons placed approximately in the proper location and then tapped to an accuracy as indicated by the vernier or micrometer is a much easier operation, even if we haven't the buttons and have to make them, than the roundabout way of taking a sample piece and drilling it accurately (?), making three counterbores for each size of bushing, and then transferring the holes from sample to jig; besides, I fail to see why, if the sample can be accurately drilled, in most cases it would not be just as convenient to drill the jig in the first place; besides, in a large majority of shops no sample is furnished, the toolmaker being expected to make up an accurate jig from the measurements on the drawing; in fact, I believe we will find that this method is becoming more and more in vogue every year and the old way of working to sample (except in the making of irregularly formed small parts that cannot be clearly shown by drawing) is gradually giving place to the concise accurate drawing which, if properly made, holds everyone responsible for his

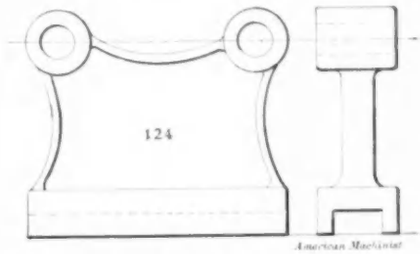


FIG. 1. CASTING TO BE JIGGED.

own work from the draftsman or designer down to the inspector of the finished piece. There is then no chance for argument as to whose fault it is that the holes in a jig are .240 inch apart instead of .242 inch, as we always have an unimpeachable witness in the blueprint.

I have supervised the making of many dies, jigs and fixtures in shops that (sad to say) were very far from "up to date," but have always had good success in using the buttons and indicator, all that is necessary being the buttons accurately made and a lathe with a face-plate that runs true, which, if not at hand, can always be made to run true by taking a slight cut off the old face-plate.

As regards the handling of pieces too large to swing in the lathe, having the vernier attachment on the saddle of the milling machine and gaging all distances by this vernier measurement is certainly one of the most accurate means of obtaining locations, but it would be few shops where we could find the milling machine fitted up in this way, as it is an elaborate and rather expensive attachment, and while it would be desirable for us to have such a fitting it has been my experience that by using the graduated dials with which all modern milling machines are now fitted and using ordinary care to see that nothing is lost through end-chase in nut or screw we get

very satisfactory work; in fact, I am speaking from actual experience when I say that I have had many jigs this way and find that they do not vary more than one or two-thousandths of an inch, which is close enough for most large jobs and for a large majority of the small ones. In fact, a large number of even my smaller jigs have been spaced and drilled on the milling machine with good success.

Laying aside all opinions as to the best method of locating jig bushing holes, let us look into some other essential points in the successful jigging of pieces for duplicate work.

Providing the piece to be operated upon (whether it is to be drilled, milled or otherwise worked) is of a uniform size and shape, such as sheet metal, cold-drawn steel, etc., it is a poor shake of a tool designer that cannot make the necessary fixtures to turn out pieces that will be perfect duplicates; but when it comes to castings we are up against another problem altogether.

I have heard the statement made many times, and by men that should know better, that castings made off the same pattern cannot have variation enough in them to take into account in ordinary jigging. Now, the parties making such statements may be right, but if so, I have always been singularly unfortunate in the selection of my foundryman, for it has been my sad experience that to send a pattern to a foundry asking for five castings from it means to have the foundry truckman drive up in about a week and deliver me five pieces of cast iron that, when you come down to fine points, neither weigh, measure up, or in some cases hardly look alike. This is not always the fault of the foundry; it may be theirs, perhaps the patternmaker's, possibly my own; but the long and short of it is that we cannot depend on getting two castings that are exactly alike, and if we want accurate work we must make fixtures accordingly.

One of the points that I wish to bring up in regard to holding irregular castings, is the matter of the support or location of them for successive operations, and this I find is very often not given the proper consideration by many fixture designers (take for an example the casting 124 in Fig. 1).

In Fig. 2 we see it set up in a milling fixture; it is supported by the permanently adjusted contact screws and nuts at *A A* and held against them by the knurled screws *B B;* also held back by the knurled screw *C* inserted in the hinged latch *D* and backed up against the cut by the permanently adjusted screw *E*. Directly back of *C* is also another permanent contact not shown in this view.

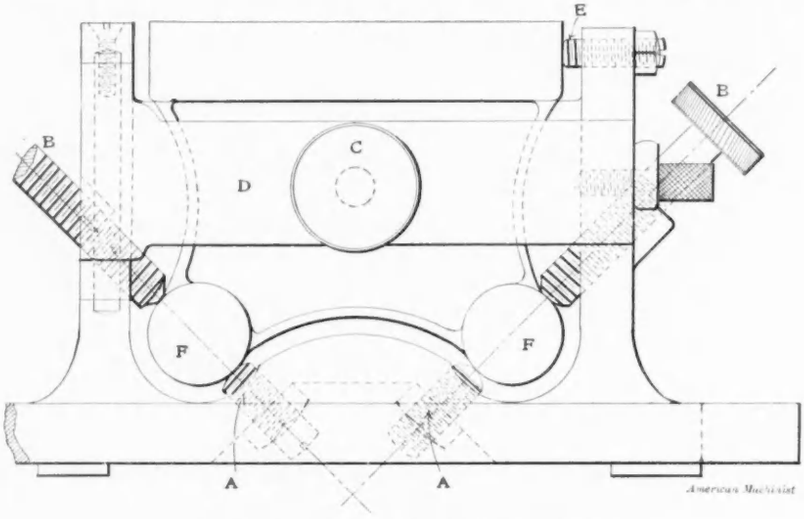


FIG. 2. JIG FOR CASTING SHOWN IN FIG. 1.

FIG. 3. END REAMER TO BE USED WITH JIG.

Now, there is nothing uncommon or new in this fixture, and the only point I wish to call attention to is the axis of the knurled screws, which for successful work should in all cases be in exact line with the axis of the contact or locating screws; this prevents springing, also shifting of the castings from carelessness in putting in, and often avoids much trouble. We support the casting at *A A* because we suppose that bosses *F F* are the most essential part; it being desirable, for appearance, if nothing more, to have the holes come in the center of the bosses.

But now comes the important part in this class of work, namely, a second, and perhaps third, operation. We are to assume that we have no finished surfaces that we can conveniently locate our castings by for future operations and have to again locate it by the rough outside. To do this properly the point most essential in laying out fixtures is, to be absolutely certain that the contact screws in all successive operations are going to strike the casting in exactly the same places as did the ones in the first setting.

A useful tool in connection with jigs, that I have used for a number of years with good success, is the square-end reamer, and for the benefit of any who are not familiar with them I submit, in Fig. 3, a sketch of the one in most common use

They are made in one piece with teeth only in the end and are fluted on the sides to give some clearance for chips, but the flutes in the sides are not backed off, but after tempering it is ground perfectly true, straight and to size.

In common use they are handled about as follows: Suppose we have a number of ½-inch holes to be drilled and reamed in a casting, and want them perfectly true and in line with each other. We make the drill jig with the common loose bushing shown in Fig. 4 and first use one with 15-32 hole, drilling through the casting with a 15-32 twist drill. We then remove this bushing and insert the square-end reamer bushing, which (also the reamer) is .497 inch diameter, then while running our reamer through, the bushing serves as a true guide for the perfect fitting reamer, and if the cutting corners are kept sharpened perfectly square the reamer will correct any error in the straightness of the hole caused by "running" of the drill.

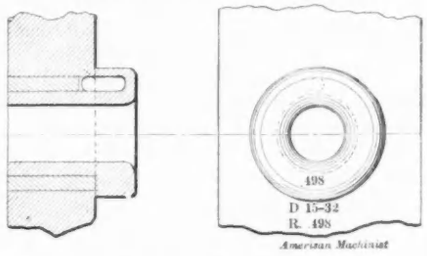


FIG. 4. REMOVABLE BUSHING.

We then have .003 inch left for hand or line reaming, which, when completed, gives us a smooth and perfect hole, and I have used these reamers as small as ⅛ inch and as large as 2¼ inches diameter, and reamed holes 10 inches long by 9-16 inch diameter, and always secured very satisfactory work. I. M. N.

A Milling Fixture.

Editor American Machinist:

It is frequently advisable to so arrange fixtures that are to be used in combinations of pairs or sets so that parts which are alike in general outline, but unlike in one or more dimensions can be held in the correct position by using the corresponding members of the device.

This is sometimes necessary because

several different sizes of machines form part of the regular product, or when it is intended to expand the line of sizes by adding an additional size, or for filling repair orders for parts of discarded sizes. Often, when the "reconnoitering" for data and information relating to dimensions of discarded and current sizes is completeed the work of designing will be found to be half-finished, or, at least, well begun. Fixtures for new or current work should be made to take care of repair work, when possible to do so without too great complication of parts and at reasonable expense, and the old jigs consigned to the scrap heap or "handy box."

In the sketches are shown devices made to comply with the foregoing conditions, and they afford also a good illustration of the efficiency of cam or eccentric motions for clamping work in position; also scratch-point gages for locating keyways at the proper distances from shoulders as shown by the dimension lines at *d*, *e*, *f*.

In Fig. 1, *A* is a spindle to be milled in two operations in lots of from 6 to 24, supported while milling at *a* and *b*. The reconnoitering developed the fact that ten fixtures with holes of different diameters would be needed to permit of finding a pair for any size of spindle, so a drawing was made for a fixture for the largest diameter and all fixtures made alike, except the diameters of holes, center hights of which were alike in all.

In Figs. 2 and 3 are shown plan and side views, and in Fig. 4 side view when open for reception of work.

B is the base which is bolted to the table and *C* a cap connected to it by a link *D* and bearing pins *F* and *E* in such manner as to permit *C* to be lifted backwards when swinging clamp, consisting of links *G* and bar *K*, is swung free, as shown in Fig. 4. To open for reception of work, handle *I*, Fig. 3, is raised turning the eccentric, to which it is "pinned," in its bearing in *B*, which slightly raises links *G* and bar *K*, allowing them to fall to position shown by dotted lines, when *C* can be raised.

To close, *C* is folded down to the work resting in *B*, the handle is slightly raised, links swung into place over *C* and the handle depressed which clamps *A* solidly.

Figs. 5 and 6 show side and end views of scratch gages for scratching lines on

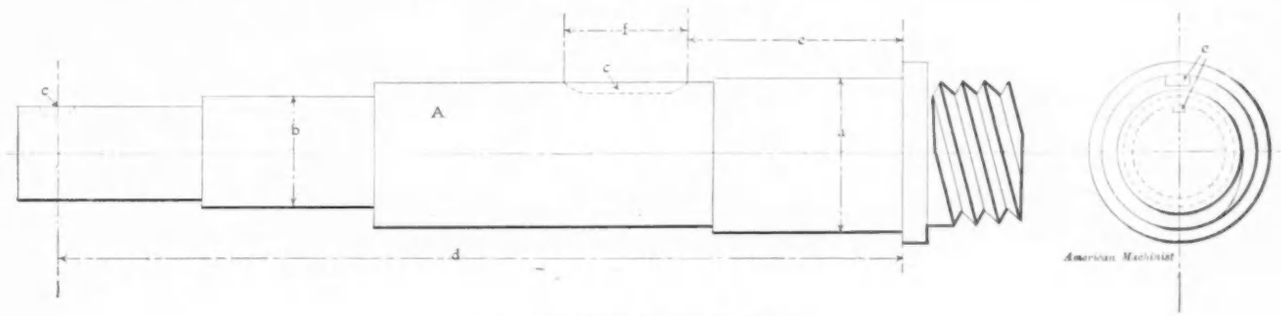


FIG. 1. SPINDLE TO BE KEYSEATED.

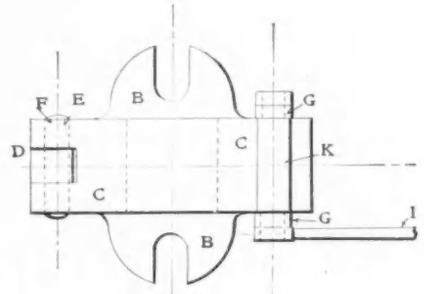


Fig. 2

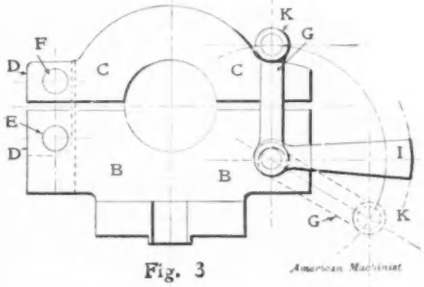


Fig. 3

PLAN AND SIDE VIEWS OF FIXTURES.

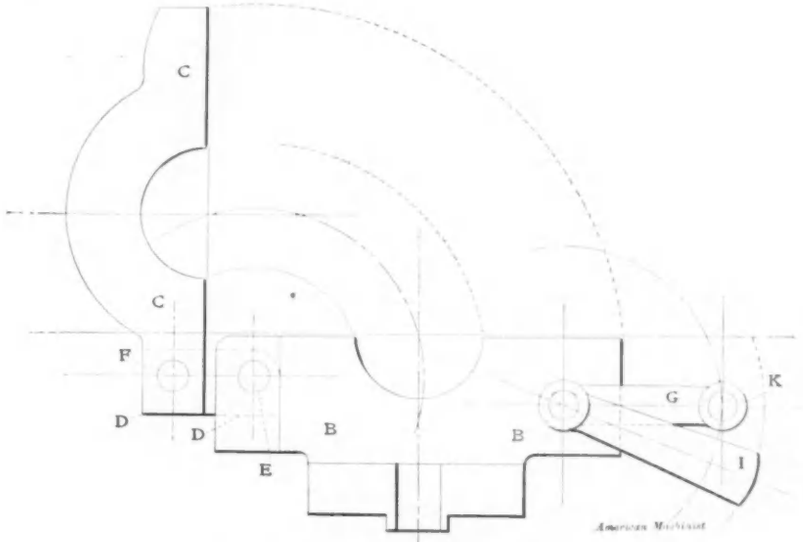


FIG. 4. SIDE VIEW OF FIXTURE OPEN.

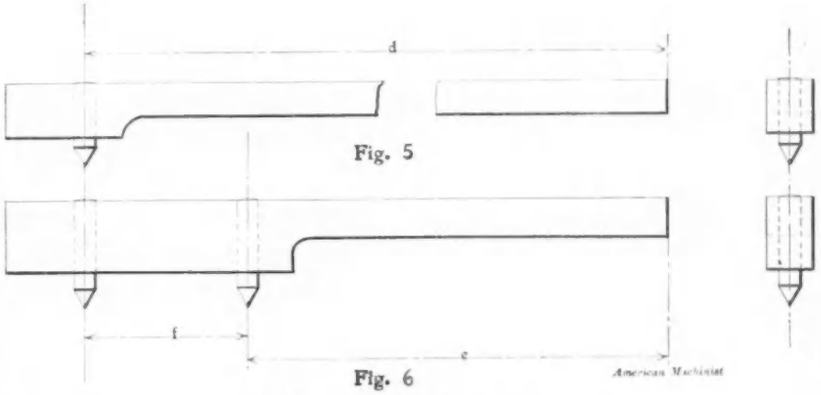


Fig. 5

Fig. 6

GAGES FOR LOCATING KEYSEATS.

chalked surfaces of the spindles before they are placed in the fixture, for locating the positions of keyways in relation to the shoulders, it being found that when operators worked from drawings it was almost impossible to obtain uniform results.

Gages consist simply of light bars with hardened scratch-points inserted at the proper distances from the ends and each gage lettered to indicate the particular size of spindle for which it is to be used.

Correct depth of keyways is obtained by making use of the graduated dial of the elevating screw of the milling machines.

A. B. CHRISTMAN.

A Boring Bar Mounting for Taper Work.

Editor American Machinist:

I send you a drawing of a rig for boring taper holes on a lathe or upright drill, describing it here as used on a drill. The bar is made in the usual style, with a traveling sleeve carrying the cutter, the feed being by a long screw with a star-wheel on the end of it. The bolt which secures the bearing for the lower end of the screw has a large internal conical center, which is thus renewable when worn. This center sets over a fixed male center in the base or table of the drill. For light cuts or short boring, the bar may be used without this center. The head *A* clamps to the end of the drill spindle. This has an offset piece extending down below it with a flat vertical face parallel with the spindle, and in this face is a dovetail cross-groove in which is the sliding piece *H*. Piece *B* holds the head of the boring bar *C* by the two screws seen in front. *B* has a flat face which sets against the flat vertical face of *A*. Two bolts through vertically elongated holes in wings on *A* are tapped into the sliding piece *H*, and when these are tightened the head of the bar is held securely to the spindle. A round boss on the vertical face of *B* projects into a corresponding cavity in the face of *H*. The drawing shows the boring bar in a central and vertical position, as when boring a parallel hole. For boring a taper hole the two bolts are loosened and the slide *H*, with *B* and the upper end of bar *C*, is moved sideways a sufficient distance to give the required taper, which may be ascertained either by experiment or computation. If the head of the bar is moved in the direction in which the cutter *a* projects, the hole bored will of course be largest at the upper end, while if the top of the bar is moved in the other direction the taper will be the other way. Now, this device is not intended for small holes such as would be easier to make with a reamer, but where it is intended for is for holes over 5 inches in diameter, and where a reamer would mean a good sum of money. When I designed this one I never expected to bore anything smaller than 4 inches at the small end, and the bar is 2½ inches diameter with a stroke or feed of 12 inches.

O. F. SCHENDEL.

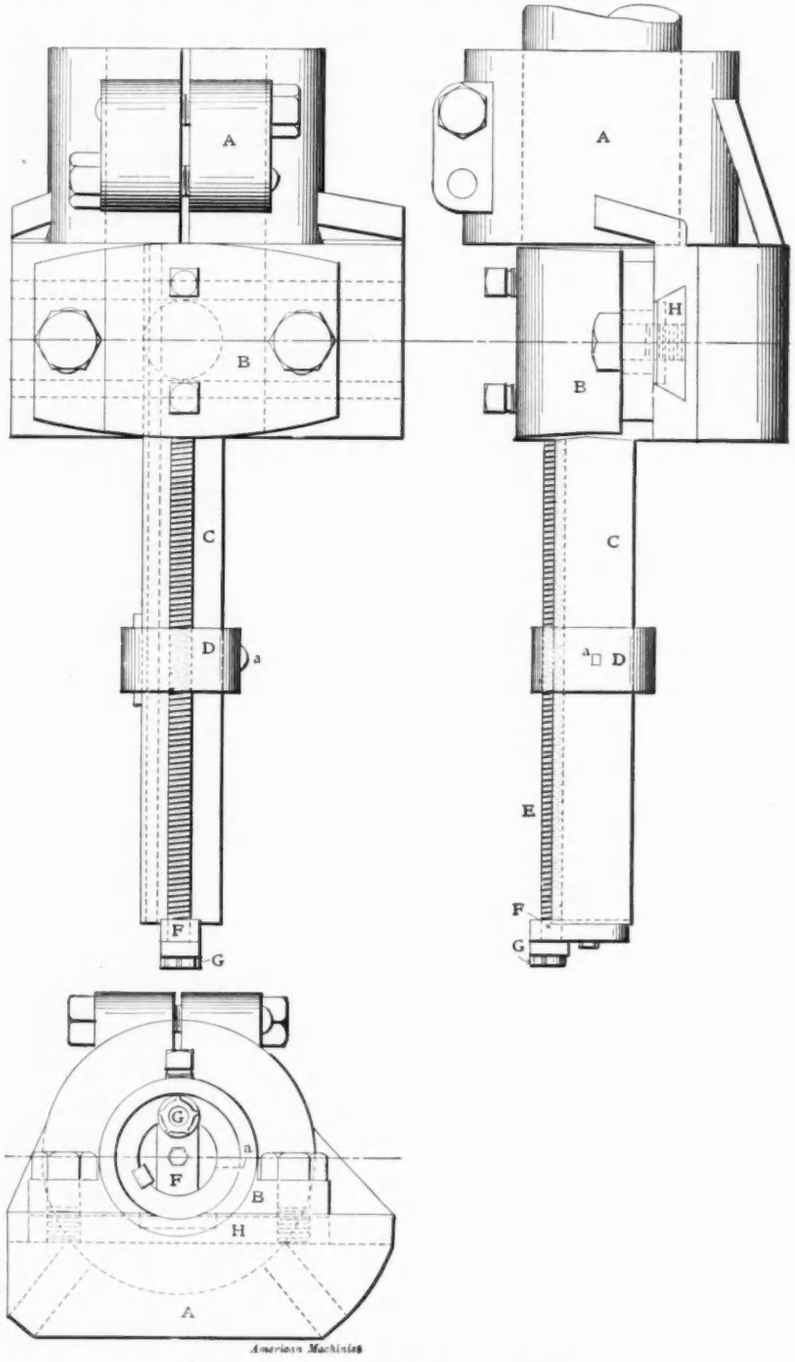
Making Teeth for Gear Patterns.

Editor American Machinist:

I notice on page 498 an article by "Old Bob" on "The Band Saw and the Pattern Shop," in which he rather slurs at the idea of using "formers" for making gear teeth, giving as one reason that the "wood butchers" will destroy their accuracy—presumably by giving the rabbit plane too long a stroke. Now, a man who cannot easily limit the stroke of his plane on such work has no place in a pattern shop. Our patternmaker planes a tooth in the former till the tool will cut no more, then shellacs the former; this makes it easy to detect if any false moves are made afterwards.

A few days ago he made a gear pattern with 90 teeth 1¾ inches pitch, using a former made only of *pine*. I marked the first tooth, and when the last was finished and compared with the first one the difference was so slight as not to be detected by feeling or by any way I could find of calipering them, and any of them agreed with the first one as well as the last one did. I do not think there are many men who can work out that number of teeth separately with as good a showing.

Then he says it's all wrong to get out the teeth separately and glue them on to the rim to "alleged" center lines. Now, that is just where the "former" teeth excel



ADJUSTABLE RIG FOR BORING TAPER HOLES.

the other style. If "Bob" will look over the directions given for making formers he will see that the part of the tooth intended for the fillet is left *parallel* and has sharp corners. The face of the rim can of course be as easily and accurately spaced off before the teeth are put on as afterwards, and lines drawn across the rim form as accurate guides to locate the teeth—by their edges—as can be desired. No "center" lines are required.

The good old way of making a gear pattern was something like this: Make the rim of cherry or mahogany, teeth the same, cut taper dovetails under each tooth, fill them with neat fitting slips, turn these off, glue the tooth blanks on them and nail them besides; then put them back in place and proceed to lay them out. If the divider point slips a little occasionally, kind o' guess how much the line is out or make two lines and forget which is which. 'Tain't very much and won't be noticed. Then work them out, either in place or take them out and to the bench vise, and when you are all done with it I will wager that teeth made on a former by a competent man will discount it all around. I think that the time taken to lay out and work out the teeth in the "old way" can easily be cut in two twice by using a former.

I wonder if "Bob" ever thought that center lines are unnecessary. The faces and flanks of a bevel gear tooth point to the center as well as the center line of a tooth would; so that in making bevel-gear patterns the edges of the teeth are placed on the lines drawn on the face of the rim. If the molder wants a tooth or two to "mend up" with, he doesn't need to take them off the pattern. If no extra teeth were originally made it is only a few minutes' work to make some that will fit. It is seldom that two gear patterns are wanted alike, so that even tho' the former was used up in making one gear it would seldom be needed again. E. S. NEWTON.

A Coil Water Cooler.

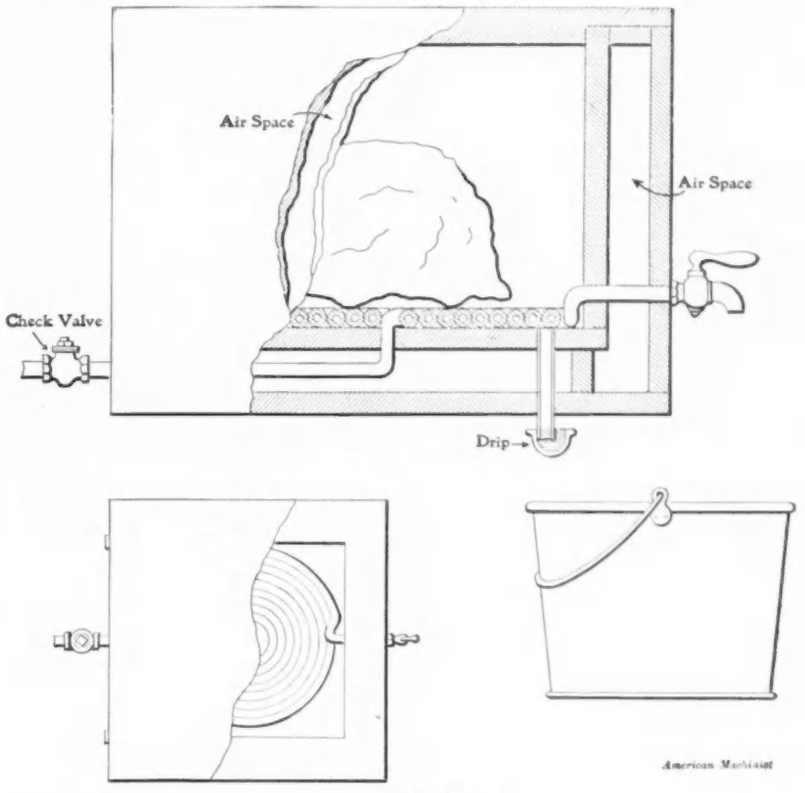
Editor American Machinist:

I give herewith sketch of a water cooler of which about one dozen are in successful operation in the works of the Wagner Electric Manufacturing Company, this city.

While the principle of a pipe coil for the purpose is not new, probably some readers of the "American Machinist" have not heard of it and this description may help such to solve the problem of securing palatable drinking water during the hot season at a minimum of expense for ice.

The sketch will make clear the general construction. The ice box proper is about 18 inches square by 14 inches high and is lined with 10-pound sheet zinc. The coil is made from ⅜-inch "medium" lead pipe with the adjacent layers lying closely together and of a diameter to fit snugly in a box of above size. Such a coil will keep cool sufficient water for twenty-five or thirty men without difficulty.

The ice lies directly on the pipe. It might, of course, be protected in some way, but it was found that if the man attending took reasonable care when placing in the ice the pipe would not be damaged and it is desirable to have as little space as possible separating it from the water to be cooled. Connection is made directly with the city mains.



A COIL WATER COOLER.

The check valve was necessary on some of the upper floors to prevent the ice water from being drawn out when heavy demands from below emptied the pipes. The drip is tipped with a return bend, as shown, in order that the water remaining there may close the opening and keep the outside air from entering.

By covering the ice with burlap or a piece of carpet it is so effectually protected that it melts very slowly and the saving in this regard will pay for a cooler in a single season. Another important advantage is that the ice itself does not come in contact with the water.

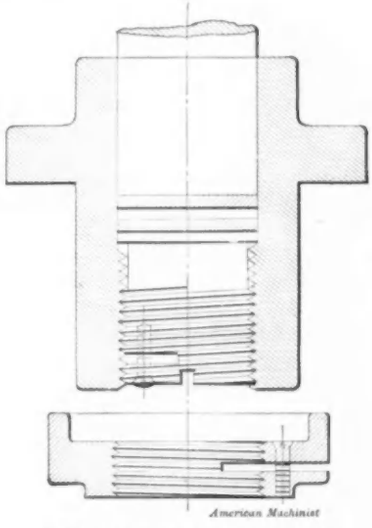
RALPH B. BOWMAN.

St. Louis, Mo.

A Lock for Screw or Nut.

Editor American Machinist:

I have been much interested in the series of descriptive lock nut articles recently published in the "American Machinist," and in relation to the article on page 490, by Mr. M. H. Westbrook, on a split clamping nut, which he mentions as an English idea, I wish to add that lock nuts which operate on this principle were adopted by Brown & Sharpe Manufacturing Company in 1892, and were used on both their milling machines and their gear cutters. Cast-iron nuts gave serious inconvenience owing to their liability to breakage, and they have been superseded by malleable-iron nuts, split and locked in the same way.



A LOCK FOR EITHER SCREW OR NUT.

This same style of nut, made in tool steel with its face hardened, I have known to be used as an adjustable stop upon reamers and counterbores having a threaded shank and working to the required depth of cut through a jig bushing. This stop does not slip under the most un-

favorable conditions and is easily adjusted when the tool is ground.

A plug supporting brass and steel disks for a heavy thrust bearing which required adjustment for wear in a special cam milling machine that I have seen, has been in use nearly three years, and with this method of locking it has given the best of satisfaction. The sketch shows the application of the principle to either a nut or a screw.

WINFRED C. RODGER.

Stud Practice.

Editor American Machinist:

In a recent list of patents was one styled by the inventor a "Pipe and Stud Wrench," and, judging from its name, I presume he intended it to be used, not only for screwing pipe, but also for screwing studs into place. If there is one thing more than another in shop practice that tends to distract a man who knows what good workmanship consists of it is to see a finished, or even an unfinished, part of a machine cut and mutilated by a sharp-toothed instrument, usually in the form of a pipe wrench, and this is exemplified more frequently in the case of studs than anywhere else. That anyone should take special pains to inform the trade that his particular invention is well adapted for this kind of work is beyond my comprehension.

Better ways than this are known, I had supposed, to all shop superintendents, but it appears that some are not acquainted with any better way than the pipe wrench mutilating system, and for their benefit I would describe a method of studding which I have always used, and which is also practiced by many others.

The instrument used for placing the stud is the old-fashioned stud nut, slightly modified, shown in section in Fig. 1; very simple, but very effective. I at one time made it with plug E extending above the nut with a head on it, by means of which adjustment could be obtained, and it was used also for releasing the strain on the stud when it was desired to remove the nut; but I found that it led to errors in determining the proper hight, and I also came to the conclusion that if the stud was so free in the hole as not to offer enough resistance for the removal of the nut it was obvious that it was too slack. Then it best served its purpose by coming out with the nut, and the adjusting screw was therefore more ornamental than useful. I now make them with the plug E a very tight fit in the body of the nut, and after being screwed in to its proper place, faced off even with the top of the nut to prevent its being tampered with. The material used is cast steel, and the values of the reference letters are as follows:

Unit D = Diameter of stud.

Radius $r = D$, to coincide with the top of the stud, whose radius also should always be equal to the diameter.

$A = D$, and determines the distance the stud shall extend above the casting and is equal to the thickness of the nut.

$B = 2D$

$C = 3D$.

I never was in sympathy with the method, so much in vogue, of screwing a stud down on to the bottom of a hole, and for several reasons, among them being that it is often used as a means of covering up defective work. An ill-fitting stud will be screwed down on to the bottom of a hole and jammed there, in some cases with a pipe wrench, to all appearances a good-fitting stud, to be discovered to be otherwise when an attempt is made to remove a nut, and, if perchance it be a close-

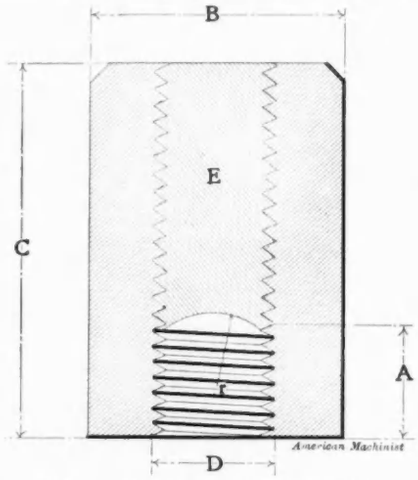


FIG. 1. SECTION OF NUT AND PLUG.

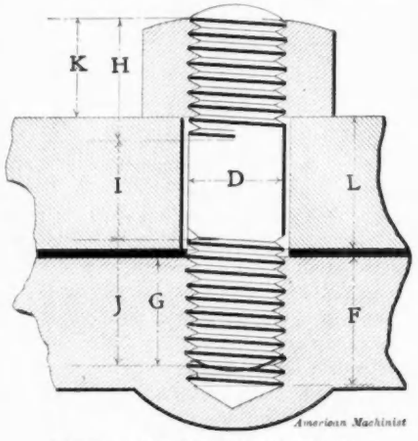


FIG. 2. STUD AND NUT IN PLACE.

fitting one, which is altogether probable, the stud will undoubtedly come with it. The circumferential friction alone between the stud and the piece into which it is screwed should be the means depended upon for holding the stud in place. I have found it far more satisfactory than bottoming the stud, and the cost of producing the work is less, for the drilling of the holes must be performed very accurately when the stud is intended to bottom. This factor, namely, the accurate depth of the hole drilling, need not be taken into account when said depth does not determine the position of the stud.

Fig. 2 shows a stud in place, and the values of the reference letters for determining the proportion of the studs, which values I use as follows: Unit

D = Diameter of stud.

$F = 1.25\,D$ = depth of hole.

$G = 1.15\,D$ = length of stud to be screwed in.

$H = 1.30\,D$ = length of thread on nut end of stud.

$J = F$ = length of thread on opposite end.

In adopting dimensions thus obtained, I use as a fractional equivalent the eighth inch next following the decimal value, depending somewhat on the conditions. The depth of the hole to be drilled should be marked on the drawing. The size of stud to be used should be obtained from a standard stud list, whose dimensions have been determined according to the above method, and its corresponding number, together with the number of studs required, should also be plainly marked. The workman, on receiving a job of studding, looks at the drawing and sees there the number required and the number designating the size, and, obtaining an order for the same, presents it to the stock-keeper who, having them arranged according to their numbers, is enabled to fill the order promptly, and vexatious delays are avoided.

In proceeding to place the studs, if for example the job be studding a steam cylinder, the cylinder is stood on end, the cylinder head is placed in position, with a few pieces of rubber between the surfaces to make allowance for the gasket; the stud is then screwed down until the stud nut comes in contact with the face of the cylinder head. No skill is required, and it is almost impossible for the man to make a mistake in determining the length or hight of the stud, unless he does it wilfully. When the nuts are in place they all present a uniform appearance, pleasing to the eye, and you have a job that will bear the closest scrutiny.

Owing to lack of attention to details on the part of the designer, it quite frequently occurs that in order to obtain a proper depth it becomes necessary to drill the hole through into presssure chambers, with the result that there is produced a never-failing source of annoyance with oozing oil, steam, water, and, in the case of air or gas, those small but expensive leaks so often found in machines of this character. This can be so easily prevented by the casting of projections on the inner surface that it is surprising indeed that more attention is not paid to this apparently trivial, yet highly important point.

MAC.

Practical Limitations of the Micrometer.

Editor American Machinist:

It is certainly true that people have different ways of looking at things, as Mr. Tecumseh Swift says, but the idea

of "Cheroot," on page 492 in the same issue, that the general introduction of the micrometer into our shops may not promote good work and good workmen, is so at variance with my way of looking at the matter that I feel compelled to say a word in protest. I have the profoundest respect for the fellow who can set a pair of inside calipers and bore a hole with them to fit a shaft just the way he wants it to fit. I also think that the best judgment is required to accomplish desired results by means of the old way of measuring, but I still think that the general introduction of micrometers into shops, modern and otherwise, is to be encouraged. Take two men, one with the ordinary caliper, spring or riveted, and the other with the "mike" and six shafts to be fitted, each shaft to be a ringing fit its entire length, so that after it has been through its bearing it shall give evidence, by its bright places, that it has been rung through. I will venture to say that if each has depended altogether on his calipers, the one who uses the "mike" will come nearer to fulfilling the requirements, and in less time.

As told by "Cheroot," that the "mikes" were set and shoved over the work in a way to cause all sorts of trouble in assembling, only shows me that the workmen were never taught to use the "mike" as it should be used, or whoever taught them took it for granted that the lesson was learned before it had been thoroughly hammered in. This taking things for granted in machine shops has caused me more trouble than all other things combined in shop work. As to "mikes" being so sprung as to be practically worthless, I think they are a long-lived tool. I have seen two within a week that have been used all of a dozen years or more, and while they are not up to a new tool in accuracy and pleasure of using, they are still sure within .00025 over or under. The calipers have not been kept in a velvet case, and have had their share of crowding over. One of the men said that it was surprising that a "mike" that had so much use could still be so reliable a measuring tool.

Now, to mention only one of the thousand and one uses about the shop where the "mike" is convenient, and almost indispensable to one who is accustomed to it, I will speak of picking out wire to be a drive fit after some drill, or *vice versa*. I think that at least nine out of every ten who have a special pocket in their overalls or apron for their "mike" would agree with me that the practical limitations of the use of the "mike" have not been reached. TWO-FORS.

"Shoving the Micrometer."

Editor American Machinist:

On page 492 "Cheroot" writes of "The Practical Limitations of the Micrometer." I will admit that the article starts out well enough and that "Cheroot" means well, but I think that if he will take the time to turn a piece of work .502 inch and then set his "mikes" at .500 inch and try to shove them over he will come to the conclusion that instead of a few gentle puffs of a cheroot he has had a pipe dream.

"Cheroot" tells us that the shop he has in mind is really up to date. If such is the case and the department foreman teaches the boys to rely on their "mikes," I think he will also teach them not to *lock* and *shove* them over, as that is not up-to-date shop practice.

"Cheroot" closes the article with the advice to use the ordinary calipers, as they are not so costly as "mikes." He might have added they are much easier to *shove*.

"KICKER."

For the Adjustment of the Reciprocal Relations of Employer and Employee.

Editor American Machinist:

Just now we are all compelled to be thinking more or less about the business relations of the employer and the employee to each other. It is impossible that we should all think alike, and yet it is highly desirable that as many of us as possible should be as nearly correct, or, what is the same, as nearly just, as possible in our views and aims. It must be evident to those of us who are mindful of the signs of the times that we are all getting to look somewhat differently than has been our habit at the problem of the reciprocal relations of the buyers and the sellers of what is in its totality the thing of greatest tangible value in the world, the headwork and the handiwork of men. That there is on both sides—so far as the matter has two sides—an increased desire and determination to look at the entire problem, instead of each looking only at his own side of it, is in itself a great step of progress.

It is not strange that disputes and misunderstandings have continually arisen over the buying and selling of men's work, for it is at its simplest a more or less complex transaction, and it has become vastly more so in these latter days. The ideal bargain is to the equal advantage of both the buyer and the seller, and to fully secure this equal advantage it would seem that both should have some say in shaping the conditions of the exchange. The growth and development of our modern industrial works have so entangled and complicated things that this is all impossible.

It is a simple thing to buy an apple from a pushcart in the street. The ticket announces the price; you put down your penny and take up the apple, and not a word need be or usually is spoken. So in the store windows the goods are displayed and the prices are placarded, and all through the buying and selling of merchandise it is usually the seller who makes the proposition, which the buyer accepts with satisfaction if not with eagerness.

It is the anomaly of the work exchange that here these conditions are reversed. The proposition in this case almost invariably comes from the buyer rather than from the seller. The would-be employer simply says: "I will give you so much a day to work for me," and the man, if he so chooses, begins to give his work for the wages. Here is as simple and as innocent-looking a transaction as one could well imagine. What difference does it make to anyone from which side the proposition comes, so that the man gets his wages and the employer gets his work done? Well, at the beginning not much, perhaps, although one need not play many games of cards to learn the advantage of having the lead.

But as the game proceeds the conditions change, so that the original bargain should in equity no longer hold. Assuming that it was exactly fair and right at first, it would then be the nicest thing in the world if some automatic device could continually readjust the wages and the work so that each would continue right in its relation to the other. This, however, can never be, and the parties on both sides must look out for their own rights. The employer needs no suggestion and little urging for him to look out for his side of the bargain, for that is his habit in all the details of his business. The successful manufacturer or shop proprietor is primarily and chiefly a buyer and seller, just as a merchant is, and may be assumed to look out for himself in the continued buying of labor as of anything else.

The workman is different. His mind is trained to run in other lines, and he is less ready to see and much slower to speak for his rights when the current of events is turning in his favor. He should aim to know when his work is worth more wages, just as the employer knows the reverse, and he should have the equal right to a readjustment when the difference of values in the work market is more than minutely in his favor. He should never assume the attitude nor accept the position of a beggar when asking for his own, although he might always be ready and willing enough to advance his facts and arguments. The proper looking out for one's self never hurts a man in his standing with an individual proprietor. No man ever fully respects anyone whom he can and does consciously and continually impose upon.

As between the individual workman and the individual employer the case is still a simple one, but the case is also becoming a rare one. The masses of the workers for wages have now for the buyers of their work companies and corporations with no approachable individual personality. The necessity and the right of the seller to scrutinize and criticise, and if necessary to modify and change the conditions of his side of the bargain are as imperative as ever, but it can no more be accomplished in the old way by man to man discussion, and by each man speaking only for him-

self, because the individual men of the two parties to the bargain cannot be so brought together, and life is too short on both sides if it were possible.

It would seem that the right thing to do, and the only thing on either side would be to narrow down the bargain making to a representative few on either side. This has been done with the greatest completeness by the buyers of work. The partners of the companies and the stockholders of the great corporations are all perfectly organized, and duly qualified and empowered representatives are appointed who can buy the work and transact all the business for the entire organization. It seems so necessary that the sellers of work also should have their organizations and their chosen representatives for the transaction of business which it is impossible to do individually that it is incredible that any should have opposed it. Proprietors have been afraid to have their men get together and talk over their affairs and attempt to make their arrangements for representative or united action, when it would have been wisdom rather to have encouraged the thing. A directors' room is of course a necessity; why not also a representative workmen's room? But no matter where the men meet, their right to do so cannot be questioned, and if they formulate conditions as to the selling of their work and empower some of their fellows to represent them and to negotiate for them, it is an outrage to spot those men, and it cannot be wondered at that it should provoke indignation. TECUMSEH SWIFT.

The Rate of Profiling.

Editor American Machinist:

On page 503, No. 18, your correspondent states that it kept a man comfortably busy to turn out 150 hand-vise parts in ten hours. Now, at the rate profiling is done in our gun works and other places, I think something must be very far wrong with the profiling arrangement or cutters that were used. R. W.

Rochester, N. Y.

Editor American Machinist:

On measuring the hand-vise jaw we find that it measures nearly 12 inches instead of 9 inches, as stated in the article. The speed of the half-inch cutter was 300 revolutions per minute, making 39.27 feet cutting speed. With 600 minutes and 25 per cent. of this time for handling the work we have 450 minutes in which to cut 1,800 inches, or 4 inches per minute. Or 1,200 revolutions to 12-inch feed, giving us .01 inch feed per revolution as a minimum. I think the feed was .013 inch, but do not remember.

Having had no gun-shop experience, I cannot say how much these figures are behind the average practice in such shops. I would be pleased to have figures from our friend. Our experience with gun-shop men would not lead us to think that they are inclined to push cutters to the limit; on the contrary, we have found it expedient to double the speed on jobs set up and started by the aforesaid "man before the gun."

We did not quote the profiling job as a record, simply as a fact, but on looking it up it seems as though it might have been worse. W. A. WARMAN.

Repairing the Cracked Table.

Editor American Machinist:

On page 496 Mr. J. Dunn tells of some trouble he had with a cracked platen, or something of that kind, and he asks for information. As I have had a little experience along the same line, I will do what I can to help to solve the mystery. In repairing a job like that, the patch should be in one continuous piece, and of a material that will swage out easily. As he put in the pieces successively and swaged them out, each one of course more or less loosened the piece next to it, and it also had a tendency to open the crack, and as the pieces were made of iron they swaged out more at the top than at the bottom and acted like wedges. He also made the slot too wide at the bottom for the width at the top, and it is doubtful if the pieces anywhere nearly filled out at the bottom. This is how I account for the pieces coming out.

Now I will suggest how I would have fixed it. I would have cut the channel about as described, only not nearly as wide at the bottom—say 3/8 inch at the top, 25-64 inch at the bottom and 15-32 inch deep. I would then have taken a piece of rolled brass rod, 3/8x1/2 inch, annealed it and then have driven it into the slot. By the time it was properly swaged out it would have been hard again; it would not spread with force enough to open the crack much, and it would not work out. CHAS. A. ROGERS.

Circular Saws.

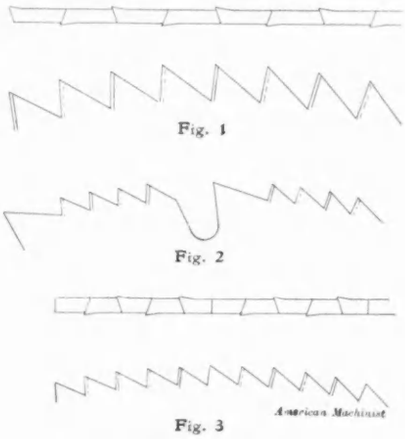
Editor American Machinist:

Referring to "Circular Rip Saw Teeth," page 501, I will admit that saws filed and gummed in that manner cut faster with less power, but when it comes to smooth sawing, then we differ. Spread set is better than spring set. In this case spring set would cause the saw to vibrate considerably more than spread set. In most lines of wood work this method of filing would be best for the sake of fast work and less power. The method on page 386 describes saws for pattern-shop use, where fast work and power are sacrificed for smooth sawing. For saws not exceeding 14 inches in diameter the teeth might be improved by using a round-edge flat file, leaving a round gullet instead of angular where a crack might start. However, on small saws, as these, this trouble is not common. Spread set is not such an improvement over spring set in this case, as there is more metal in the tooth to absorb the vibration. I am not arguing in favor of spring set, though it can be done easier and will do in this instance. A piece of emery, a block of iron, a hammer, vise and file complete the outfit, which the poorest shop is sure to have. I still maintain that less gullet, more tooth and not much rake produce the smoothest work. As I invited discussion on this subject, I wish to thank Mr. Porter for his suggestions. M. E. W.

Pattern Shop Circular Saws.

Editor American Machinist:

In a small pattern shop, where the circular saw frame had but one arbor, was a saw something like Fig. 1, which was supposed to both rip and cut off but did neither very well for pattern shop use. It might have done first rate to saw cord wood. The proprietors were persuaded



PATTERN SHOP CIRCULAR SAWS.

to purchase a combination saw like Fig. 2. You ought to see the difference in the work produced. Such a saw is especially adapted to a single arbor saw frame, as it has both rip and cross-cut teeth, and accomplishes the work of both. The maker claims that this saw needs no set, as it is concaved, but under such conditions as a saw is put to in most pattern shops, a little set is to be desired. The saw without set begins to get a little dull on the points, and then the work pinches, which makes filing necessary. The saw with set leaves more clearance in the kerf, so that the work does not pinch as soon, giving longer service for the time expended in filing. Of course some smoothness is lost, but not enough to mention. If the saw first mentioned, Fig. 1, had been a fine-tooth cross-cut saw, like Fig. 3, with every fifth tooth filed square across, as shown, it would have accomplished much that the combination saw did. Anyone who has a fine-tooth cross-cut saw could try this with light expense. It's a mystery to me that pattern shops are not better equipped with such important labor-saving devices as good circular saws. M. E. W.

Another Method of Making a Square

Editor American Machinist:

I read Mr. Christman's article on "A Knife Edged Square" in No. 6 with interest. I made a square similar to his, but doing away with the testing block, without which my friend, Mr. Christman, stated the square was useless.

I ground and lapped the beam on all four sides, making the opposite sides perfectly parallel; then rounded the four edges slightly. After that, stepped over to a Pratt & Whitney bench lathe, took a piece of rod brass in a spring chuck and bored out to fit the beam, slid the beam in, letting it touch the bottom of the hole, put in a grinding attachment and ground the end off, and the job was complete. If done carefully, it is close enough even for his work, or, you might say, for all practical purposes.

Now assemble the square and take a bevel protractor, set it so it will shut out light with your square. Next loosen the screw holding the beam, and turn halfway around and tighten again. If your square shuts out light again with the bevel protractor you can be assured it is perfect. If it shows light the error is only half of what it shows, in which case it is the fault of the man and not the method, but it can be easily remedied with a few touches of an oilstone.

G. DEGENER.

[It should be kept in mind that this precision square subject was commenced by a description in No. 1 of a method of making a square in which the degree of refinement was carried far beyond the point of shutting out light, and we doubt very much if the method described above would produce a square that would stand the test described by T. H. Miller in the first article, though it is of course interesting considered by itself. Ed.]

The Strength of Flat Cover Plates.

Editor American Machinist:

In your issue No. 18 I find in the Questions and Answers column an inquiry for a rule for determining the proportions of cast-iron heads without stays.

Rule: To find the thickness of flat covers in inches, divide the length of the shortest side if rectangular, or the diameter if circular, in inches by 120, and multiply the quotient by the square root of the pressure of steam in pounds per square inch. Formula:

$$t = \frac{l}{220}\sqrt{P}$$

GEO. JONES.

Engine Counterbalances.

Editor American Machinist:

In your issue No. 18, in answer to question 14, it would have been well to mention that in every case the whole of the revolving parts have to be fully balanced. This should be evident to anyone, but is not, as I found in the course of some correspondence on the subject in "Engineering" some few years back. I know quite well this is known to your writer, who, understanding the subject, regards mention of the fact as superfluous. But I *feel* that it ought decidedly to have been mentioned for the benefit of those who don't know. The twelfth line from the top should read "to the whole of the revolving, plus the whole of the reciprocating" and line 7 from the end ". . . balance the whole of the revolving, plus one-half of the reciprocating parts." H. R.

[Our correspondent's point is well taken. Ed.]

An Old Way of Turning Tapers.

Editor American Machinist:

In answer to "Young Fellow," who asks for a method for turning tapers in a lathe, I remember when I was a cub seeing the lathe hands loosen the gibs underneath the carriage and insert a taper strip between the carriage ways and the V of the bed, this would, as the carriage advanced, raise the point of the cutting tool and turn the work tapering. I am not quite sure if it would work on such a quick taper as he mentions. I think if I had that job to do I would (if the lathe had a compound rest) take out the lower cross feed screw and put a stud with a roller on it on top of the rest apron, then a piece of flat iron with a slot to fit the roller secured to the lathe bed and set at the proper angle, would do the job all right.

OLD FELLOW.

There are Wrenches for the Thin Check Nut.

Editor American Machinist:

Referring to page 382 of your issue No. 14, and to the communication of your correspondent, J. H. S. Phillips, of London, we are making a line of thin check-nut wrenches especially for the purpose of which he speaks in his communication printed on said page. He says there is no wrench for the thin nut when placed inside. This is merely to show that there is such a wrench, or that there can readily be one wherever it may be needed.

J. H. WILLIAMS & Co.

Brooklyn, N. Y.

The Milwaukee Meeting of the American Society of Mechanical Engineers.

The first session of the Milwaukee meeting convened in the assembly hall of the Plankinton House at 8 30 P. M., in accordance with the program we have previously published, about 150 members being present. Prof. Warren S. Johnson, chairman of the Local Committee, made an address, in which he welcomed the visiting engineers in the name of the local members and on behalf of the city. He said that the strikes that were taking place in many of the shops would make necessary important modifications of the previously arranged program. He said that the visitors might have noticed in coming into the city that Milwaukee was "famous." He said it was famous for various things, but he thought it was entitled to fame for some productions not so generally credited to the city as they should be; calling attention to the fact that while the production of beer in Milwaukee amounted to the value of about $12,000,000 per annum, the value of its manufactures other than beer amounted to $150,000,000 per annum, a very large proportion of this being machinery. Among other things, Prof. Johnson said that Milwaukee produced more leather than any other city in the United States.

President Samuel T. Wellman, responding on behalf of the society, said that while it was generally understood that Milwaukee was famous for its beer, he believed that, judging from the program that had been arranged by the Local Committee, Milwaukee would hereafter be famous among engineers for the spring meeting of 1901. He believed that members had done well to come away from home and the strikers, and hoped that by the time they got back they would find the strikers back in their places where they belonged.

After some announcements of minor importance by the secretary, the presentation of papers was taken up, that by W. S. Aldrich being the first and Mr. John Riddell's the second; these papers being, at the suggestion of the secretary, discussed together instead of separately.

Requirements of Electricity in Manufacturing Work.

BY W. S. ALDRICH.

The author considers it to have been proven that electric driving leads to a large increase of output and states that the system has led to increases of from 30 to 40 per cent. per square foot of floor space, from 20 to 60 per cent. per machine and from 10 to 30 per cent. per man, with a reduction of from 25 to 45 per cent. in cost of production, while he states that "with many manufacturers it is still a question whether the electric drive costs more to install and to maintain than the belting system" and that "in many cases electricity has effected a saving during the first year that has more than paid for the change to the new system." He also considers that "electric light must be supplied in these times in all shops where they make a practice of doing a day's work the year round."

The argument is considered to be all in favor of electricity, though it is not easy to find a basis for such statements as that "it reduces the sick list to a minimum," that "it improves the morale and personnel of workmen" and that "it conduces to shop order and discipline."

Portable Versus Stationary Machine Tools.

BY JOHN RIDDELL.

Several of the portable tools shown in this paper have been illustrated in our columns. To make the comparison with stationary tools more effective several half-tones of stationary tools doing the work for which the portable tools are adapted are given. Comparisons are made between the investment cost of the two classes of tools and figures are given for the time consumed in doing the same pieces of work by the two classes of tools. These comparisons from both standpoints are very decidedly in favor of the portable tools.

In discussing electric transmission, particularly as applied to machine tools, a member presented a written discussion by an associate of his, named Frankenfield; Mr. Frankenfield taking the view that, in the discussion of electric as compared with other drives, the coal pile had been given too prominent a place. He thought that economy of coal was the least important feature and that the most important was the facility given by electricity for favorable grouping of machines and for consequent increase of efficiency. He believed that the group system of driving machine tools would probably prevail for some years, but seemed to think that eventually the individual-motor system would supplant it. He thought that in grouping machine tools groups of planers, of lathes, drill presses, etc., should not be arranged together, because when a portion of these machines were, for any reason, not operated, the motors would then be working underloaded, and consequently at low efficiency. He thought it better to arrange groups of tools consisting of the various leading machine tools used in the shop, so that when for any reason the shop was only partially occupied, such groups could be used, throwing out of action the other groups and thus maintaining higher efficiency than is possible usually under the common grouping system. He instanced the case of a large turret lathe as being probably the most favorable case for the application of an individual motor, owing to the demand for a large range of speed with practically constant power consumption. He thought that variable speed motors were important and that for machine tools they would eventually be the only kind of motors generally used, such motors being far preferable, in his opinion, to those of constant speed where the variations required had to be obtained by trains of change gears. Commenting on the statement in the paper regarding the use of direct-connected dynamos, the opinion was expressed that these are not so important as had been assumed, but that, on the contrary, rope or belt-driven dynamos were entirely satisfactory.

Another member called attention to the importance of having in works where many motors are employed one man who thoroughly understood the motors and was thoroughly competent to keep them in good working order. His experience had been that in many places where motors are used the general impression seemed to be that the proper thing to do with the motor was to let it entirely alone, which resulted in trouble and caused motors to fail frequently for very absurd reasons. He instanced a case of shopmen allowing an armature shaft to run dry until it had seized in the bearings and then sending five hundred miles for an electrician to come to "see what was the matter with that motor."

Prof. Benjamin, of Cleveland, sent in a written discussion presented by the secretary, in which, while he endorsed the use of the motor for driving machine tools, said that he had made many tests showing that so far as frictional loss was concerned the difference between the electric motor and belt or other forms of mechanical transmission was not material; but that it had been shown, he thought, conclusively, that the electric motor did increase the production per man and per unit of space.

Mr. Riddell, in closing, gave the results of some of his own experience, and instanced a boring and turning mill which had required seven belts to drive it and a 20 horse-power motor to furnish the power, but which when direct driven by motor had been easily handled by a 10 horse-power motor. He also related the effect of direct electric drive for planers, using the electric clutch which we have published a full description of, and said that their experiments had shown that, by the belt drive, the table of the planer had usually moved about three feet before getting up to its full speed, but that with the motor and the clutch he believed that it attained full speed within three inches of the reversing point.

Prof. Aldrich, in closing the discussion upon his paper, emphasized his position as to the increased efficiency resulting from the employment of motors and said that while it had in many cases proven impossible to materially increase the speed of machine tools driven by belt and cone pulley it had been easy to do it when driven by a motor because the man had nothing to do but to touch a button or move a small lever to secure gradual acceleration of cutting speed up to the point of the maximum endurance of the tool without attracting the attention of his shop neighbors, the author seeming to think that in many cases opposition of shopmates acted as a powerful deterrent to the attainment of maximum cutting speed.

Prof. Johnson instanced a large printing press which had been arranged to be driven by electric motors and which had buttons arranged at various parts of the press so that the operator could, by pressing a certain button, start the press and, so long as he continued to press the button, the speed of the press would be gradually accelerated, and when he removed his finger from the button the speed would remain at that point. From the same position or from any other position about the press where it was likely to be needed he could either still further increase the speed or, by pressing another button, could decrease it until, again removing his finger, the speed would remain constant at the lower rate. Another set of buttons conveniently distributed enabled the press to be instantly stopped from any position. Prof. Johnson said that this result could not have been attained by any mechanical drive or system.

President Wellman, referring to rolling-mill practice, said that the recent very large increase of capacity that had been effected in rolling mills was due very largely to electrically driven appliances for handling material.

As frequently happens, a good deal of discussion fully as interesting as that which takes place during the meeeting, took place among the members after adjournment and a promiment machine-tool builder, who is himself a believer in and a considerable user of electric motors for various purposes, said that one might think that some of the members who had discussed electric driving had really never seen a modern machine tool. He went on to state that in a great many modern machine tools four different rates of speed could be obtained by the moving of the lever and without any shifting of belts and, referring to a statement made in the meeting regarding the possibility of gradually accelerating the speed of such tools for instance as the boring and turning mill, taking a facing cut, said that such gradual and automatic acceleration was quite possible by mechanical means and devices for effecting it had been already applied to cutting-off machines and various other tools. Another member wondered what could be done with electric motors in the case of driving planers in the way that is now being done—with the Reeves Variable Speed Countershaft, for instance; the regular way of applying this counter being to so arrange it that the return movement of the platen is constant and at the maximum for the given machine, while the operator can, by moving a lever, instantly vary the speed of the cutting stroke in accordance with the demands of the work, variations in metal, character of cut, etc., without affecting the rate of the return movement.

At the close of the meeting a "smoker" was tendered the visiting members by the local committee, which was held in the main dining room of the hotel, the members being gathered about the tables discussing electric drives, the machinists' strike and some of the products for which Milwaukee is famous, and having a general good time. Among other things of interest was shown a new design for an automobile, which was exhibited by Mr.

Fred Low, of New York, and which possesses some novel features not heretofore included or thought to be necessary in automobiles.

WEDNESDAY MORNING'S SESSION.

The first order of business at Wednesday morning's session was the reading of the report of the tellers of election, but the names of the newly elected members were not read.

Then the secretary read the report of the Committee on Junior Meetings. This report, after giving an account of what had been done during the past winter, recommended that the Junior meetings be discontinued, and the Council had so decided. A committee of the Council now has under advisement the question of meetings between the regular meetings now held, and is to report later.

An invitation was presented to hold the next spring meeting at Saratoga, which would be within reach of the industries of Schenectady and vicinity, and the president said that the Council had the matter under advisement.

The report of the Committee on Standardization of Methods of Making Engine Tests was deferred, because no member of the committee was present, Prof. Jacobus having telegraphed that he would arrive Thursday, and asking its postponement. The first paper taken up therefore was

The Practical Application of Superheated Steam.

BY G. A. HUTCHINSON.

This paper, like the one which follows it, is an attempt to place before American engineers an account of the degree of success which has attended the use of superheaters in Europe, and more especially in France and Germany. While there are in Germany no steam plants of a magnitude comparable with many of our own, there are, nevertheless, several of a capacity of 2,500 horse-power, or thereabouts, to which superheaters have been successfully applied, while several thousand smaller installations exist.

The author of this paper considers that superheating has passed the theoretical stage and may be considered an engineering success. His observations have not, however, shown such complete freedom from annoying difficulties as have those of Mr. Foster. Thus, of the danger of burning out the superheater, he says that "while it cannot be eliminated . . . it has been minimized." Again, he says that " more careful and more plentiful lubrication is required, unquestionably, than with saturated steam," and that "the lubrication difficulty prevents the use of unbalanced slide valves with very high temperatures and compels the application of poppet valves or completely balanced piston valves." Moreover, he does not find such high temperatures in use—475 degrees Fahr., at the throttle, being given as the maximum. He has found that "a net gain in economy of 10 to 15 per cent. is a common result, while a saving of 20, 25, and even 30 per cent. is by no means uncommon. Of course the largest saving is made with the most wasteful type of engines." More than half of the paper is composed of illustrations and descriptions of different makes of superheaters.

Prof. Hutton suggested that the discussion on this paper be deferred until the next one had been presented and then the two be discussed together, which was agreed to.

Superheated Steam.

BY E. H. FOSTER.

This paper opens with references to early attempts to use superheated steam and to experimental researches by then Chief Engineer Isherwood, U. S. N., which demonstrated marked economy from superheat, but which also disclosed practical difficulties which then seemed to be insurmountable. These difficulties arose chiefly from the decomposition of the animal oils then universally used. The introduction of mineral oils and the use of metallic packed stuffing boxes has changed all this, a fact which European engineers have been the first to recognize, and in consequence of which they are now far in advance of ourselves in the use of superheated steam.

According to the author, there are now several thousand successful installations of large and small superheating plants in Europe, and no economical steam plant is there seriously considered without superheaters.

The author then goes on to show why superheating is economical and to give an outline of European practice. The temperatures used range between 500 and 600 degrees Fahr. A good deal of rivalry exists between the use of cast and wrought iron as the material for superheaters, but the author favors cast iron for general use, because of greater durability and greater mass of heated metal which serves to equalize the temperature. He considers, however, that wrought iron has its useful field where lightness and compactness are essential and where a moderate degree of superheating only is required.

The author has inspected cast-iron superheaters which have been in use for six years without trouble or deterioration. He considers that a special field for superheaters is in plants in which steam is conducted from a central boiler plant to engines at a distance, the superheaters in this case being located near the engines. He was unable to obtain any testimony derogatory to the practice, while all testimony agrees that it uniformly results in a gain in economy. He expects the practice to give the triple-expansion engine a setback, and records a prediction that with the aid of superheat a horse-power will be easily developed from 10 pounds of steam per hour. Records, in fact, already exist of a performance of 10.42 pounds in one 800 horse-power engine.

Mr. Scheffler called attention to the Potts mesh separater, which produced some superheating and in some cases decreased the water in the steam by 60 per cent.

Prof. Goss, being called upon by the president for his experience with superheating in locomotives, said he had no personal experience to relate, but that in the case of two or three German locomotives that had been equipped with superheaters he believed it had been found that there was about the same economy as with compounding, but that there was more or less trouble with the superheater. He thought the papers were good, but that they contained nothing startling. He believed that American engineers had fully appreciated the advantages of superheat, but that they had preferred to get the desired economical results in some other way.

Prof. Storm Bull said that superheating had been neglected in America, and that it might as well be acknowledged.

Chas. G. Y. King related a case of carrying steam through a pipe about 600 feet long in which a superheater in the form of an upright boiler placed near where the steam was used, and fired lightly, had produced very favorable results.

Another member said that where the load varied widely superheat was a difficult thing to handle, because when the load fell off, the degree of superheat often rose to such a temperature as to make trouble. He had burned out gaskets and even ruined brass valves by steam excessively superheated in this way.

Drafting Room and Shop Systems.

BY F. O. BALL.

This paper was originally read at one of the Junior meetings at the society house last winter. It gives many features of the drawing-room practice of the American Engine Company, including the methods of transmitting orders from the drawing room to the foundry and machine shop, the system of numbering the patterns, the pattern record book, etc., and some features of the cost-accounting methods.

At first sight the plans described impress one as involving an undue amount of clerical work. One also feels, when reading the paper, that the author is not sufficiently acquainted with different lines of work to make due allowance for the changes in methods which are necessary to meet different conditions.

This paper called out a good deal of discussion, which was participated in by J. Sellers Bancroft, C. L. Griffin and others, the general trend of which was that no universal system could be devised and that the system and rules given in the paper were very far from being generally useful. S. L. G. Knox, of the General Electric Company, showed that it would be utterly impracticable for their purpose, among other reasons being that it would require them to make about 1,000,000 blue-

prints per month. He gave an account of the system used there, by which each drawing or drawing sheet was made a complete record of all that had been done with the part shown. Another member criticised the system because it made no use of cards, which he considered an essential part of any modern system.

Blue-Printing by Electric Light.

S. L. G. KNOX.

The apparatus described in this paper uses the usual blueprint frames as made for use with sunlight. They are placed on trucks with a swivel arrangement for turning over. The source of light consists of two enclosed arc lamps with opal globes enclosed in a metal hood hanging downward so that the opening faces the upturned frame. The hood is curved to parabolic outline and is finished on the inside with white enamel. Lamps and hood are hung by a trolley from an overhead track so that they may be pushed from one frame to another and so make an exposure in one while another is being changed. The time required for an exposure is said to be from three to four times as long as with bright sunlight. The advantage of the arrangement is of course that with it the making of prints is independent of the state of the weather.

The author in presenting this paper explained that, while the interior of the reflector must be white, so as to reflect light, yet it must not be bright, and said that when they had tried a reflector with a bright surface the result had been that the blueprint was reflected and re-reflected from the surfaces and printed in various positions upon the paper, making what was, perhaps, one of the most curious-looking blueprints ever seen. Some of the members brought up the subject of the heating of the glass, owing to the fact that devices used for concentrating the light upon the paper had the effect also of concentrating the heat at the same place. The author stated that no trouble had been experienced with heating, this being due partly, he thought, to the fact that ventilators were used at the top of the reflectors, thus causing a current of cool air to be drawn in from the room. Messrs. Blood and Hunt and President Wellman related their experience in the use of the blueprint apparatus supplied by the Pittsburgh Blue Print Company, which we have illustrated, saying that no trouble had been experienced with heat and, in fact, no trouble of any kind, the apparatus having proven satisfactory in every way; it being possible to make prints at all hours, in all weather, at short notice, and at such a low cost that the cost of the apparatus had, in Mr. Wellman's case at least, been repaid by two months' use.

Rules for a Drawing Office.

BY A. W. ROBINSON.

The rules here given are a revision of a set given by the author in a paper read before the society in 1894. They cover most of the points which can be incorporated in such rules and are sensible and to the point.

There was no discussion. Owing to the fact that the report of the committee previously named was not ready for presentation, some time remained and papers designed to be presented Thursday morning were asked for. Some of the authors were not present or were not prepared to present them, however, and consequently the only additional papers presented were:

On the Influence of Titanium on the Properties of Cast-Iron and Steel.

BY A. J. ROSSI.

After mentioning the abundance of titaniferous iron ores and the fact that they are being successfully smelted, the author goes on to record the results of tests on iron and steel containing varying percentages of titanium obtained by adding titaniferous iron to ordinary cast iron and to crucible steel. In the first experiments made the percentage of titanium was so small that it is hardly supposable that it could have any direct result, the increase of strength noted being attributed to some indirect and unexplained action.

For purposes of comparison tests were made on cast iron containing up to 6 per cent. of nickel, then on iron containing both nickel and titanium and finally on iron with titanium only. The conclusion drawn is that even with the titanium in minute percentages the strength and chill are both increased and at lower cost with titanium than with nickel. With the addition of larger amounts of titanium—4 per cent. of a 10 to 12 per cent. titanium alloy—an increase of 20 to 25 per cent. of transverse and of 30 to 50 per cent. in the tensile strength of the metal was obtained. The mixture was made in either the crucible or the ladle—not in the cupola.

The experiments on steel were confined to crucible steel of medium and high carbon percentages and the results were uniformly an increase in the ultimate strength, elastic limit, contraction of area and elongation, while tools made from the treated steel were found to be excellent.

The paper concludes with a brief account of some of the details of the operations of smelting the titaniferous ores.

There was no discussion on this paper nor on the other, which was

A New Connecting Rod End.

BY C. W. HUNT.

This paper describes a connecting rod designed by the writer, who makes for it the claim that less skill is required for its satisfactory construction than where flat surfaces are employed and the slotting machine or the shaping machine is called into requisition. The take-up is by means of a cylindrical plug placed at an inclination of about one in ten to the axis of the crank pin, one side of the plug being cut to fit the circle of the exterior of the bushing to be adjusted, and a screw with collars bearing against shoulders on the ends of the inclined plug adjusts the latter as minutely as desired and holds it securely. The arrangement may of course be used either for rods with solid ends or with half boxes to go over a solid crank. The drawings accompanying the paper give the arrangement a neat and mechanical appearance.

The afternoon was devoted mainly to sightseeing among the engineering workshops of the city, most of the members visiting the works of the Allis company, in which they were interested particularly in one of the engines to be installed for the Manhattan Elevated Railway. At the works of the Nordberg Manufacturing Company some very interesting engines were seen also which were studied very closely by those of the members particularly who are interested in steam engineering. The shops of the Filer & Stowell Manufacturing Company, the Viller Manufacturing Company, the Christensen Engineering Company, and the Bucyrus Company, at South Milwaukee, were also visited by different groups of the party, the choice being based upon individual interest. The machinists' strike caused these shops to present a somewhat different appearance from the normal one, and work was not being carried on in most of them as usual, although in the works of the Nordberg Manufacturing Company the complement of men seemed to be pretty nearly complete, and Mr. Nordberg said there had been very little trouble. Many men were out of the Allis shops, however, and there were very few working in those of the Viller Manufacturing Company, one of the unusual spectacles of this establishment being one of the Viller brothers, who had started life as a working machinist and worked up to the proprietorship of this shop, with his sleeves rolled up, a suit of blue overalls on and attending to a boring and turning mill. He declared that he liked it and found that it came very handy to manipulate the machine. He was twitted somewhat by the visitors on the fact that he appeared to be running the mill at a somewhat higher speed than would be sanctioned by the union rules, but he declared that for that time at least and for that particular tool he thought he should be able to have it run at the speed dictated by his own judgment.

The reception and conversatzione at the Deutsche Club in the evening proved a most enjoyable affair and to the surprise of the guests turned out to be something more than the usual reception, as there was, in addition to the usual features, a banquet which was served late in the evening and evidently was very much enjoyed.

THURSDAY MORNING'S SESSION.

The meeting was called to order by the president at 10.30, and, Professor Jacobus having arrived, he presented the

Preliminary Report of the Committee Appointed to Codify and Standardize the Methods of Making Engine Tests.

This report is an attempt to place the testing of engines on the same satisfactory basis that the testing of boilers has been placed by the boiler test code of the society. It is of a character which makes it scarcely possible to present a satisfactory abstract.

The committee has endeavored to secure a plan of testing of such breadth as to prove sufficient for the purpose, whether that purpose be scientific investigation, a practical determination of everyday performance in the interest of the owner of the engine, or a determination of the capability of the engine in the interest of its builder.

The report covers tests of steam, gas and oil engines and concludes with forms for recording the data and results of the tests, two forms being given for use in the case of steam engines, one being a complete form and the other a short form, from which some of the minor items are omitted.

In discussion, W. W. Christie questioned the figures given for the mechanical equivalent of heat and advocated 778 instead of 774, as favored in the report. Professor Thurston referred to the standard of efficiency named in the paper and did not think that the British standard was consistent; he also objected to the three-way cock and favored attaching the indicators as close to the cylinder as possible, doing away with the long pipes made necessary by the three-way cock. E. T. S. Vederholm referred to the ideal diagram given in the report and to the straight clearance line therein. He thought there was some objection to this and that by producing an offset in the diagram the entire hyperbola was made right for the expansion line, doing away with the variation between the actual expansion line and the theoretical expansion line. He instanced a case of a marine engine where the diagram being constructed in the way advocated by the report the number of expansions of the engine was made 19, whereas when computed by the method he recommended the number of expansions was made 13. Professor Jacobus, in closing the discussion, said that he agreed with what had been said about the three-way cocks. He also thought it was best to recommend that its use be avoided. Regarding the ideal diagram, he said that the method of constructing it shown in the report had been adopted by the committee simply because that method had been generally used, and for that reason it was thought best to make use of it, except in such cases as would lead to objectionable errors. For such cases the method mentioned by Mr. Sederholm was recommended in the report itself.

Following this was the presentation, by J. B. Stanwood, of the preliminary report of the Committee on the Standardization of Engines and Dynamos. Mr. Stanwood reported that the committee had held two meetings and had conducted a voluminous correspondence with manufacturers of engines and dynamos, the result being very favorable to the establishment of such standards as the committee were considering, the few exceptions having been met and embodied in the report, so as to remove apparently all liability of serious dissension. The Engine Builders' Association had also at a recent meeting adopted a resolution endorsing these standards. A member, in speaking of the percentage of overload allowed for by the committee, said that in railroad work, in which he was interested, the percentage of overload commonly allowed was very much greater than that contemplated in the report. He said that 100 per cent. momentary overload was allowed, and 50 to 75 per cent. overload for periods up to three hours. Mr. Mansfield referred to what he called the 5-per-cent. clause, and asked for some explanation of it, saying that, while it was a good thing for the engine builders, yet in his experience the engine builders had been required to give the exact speed demanded by the generator, and he did not quite understand whether this report contemplated allowing the engine builder to go 5 per cent. below or 5 per cent. above the nominal speed, or just what was meant by it. Mr. McFarland, a member of the committee, in explanation of these and other points, said that the report did not refer to alternating currents but only to direct currents; though it was expected that the final report would include the alternating current. He said that in corresponding with dynamo builders it was found that some of them would run as much as 5 per cent. below the speed adopted by others. The 5-per-cent. allowance had been made therefore to bring such cases within what might be called the standard, and the committee had not concerned itself with the commercial questions of differences of cost arising from the fact that one builder might contemplate running his generator 5 per cent. slower than another for generating the same current. That he considered was a matter that might properly be left for settlement between the manufacturer and the buyer. The secretary announced that in the interval between now and the fall meeting written discussion of both these reports would be welcomed and transmitted to the committee for such action as seemed to them appropriate.

At the conclusion of the discussion on these reports discussion of Mr. Rossi's paper was taken up, this having been presented out of its turn on Wednesday, when Mr. Rossi was not present. He had with him specimens of some of the iron that had been alloyed with titanium, which were examined by the members with great interest, and in reply to questions which were invited he explained at length his experience with these alloys. The president, in closing the discussion, said that titanium had generally been considered by metallurgists as the "greatest devil" in ore, and that if a man were told that an ore contained any titanium he would usually refuse to have anything to do with it. He thought, however, that its use as a hardener was likely to increase, and that it might be particularly important in the working of some Canadian ores. The president finally remarked that the United States Steel Company had now obtained control of practically all the United States ores, and that we therefore should be obliged to go to Canada for ores, which ores contained a very large percentage of titanium.

A Few Instruments of Precision at the Paris Exposition.

BY W. E. REED.

Many of the instruments described in this paper are for astronomical purposes. Speaking generally the author saw in the French instruments exhibited a high degree of workmanship and especially of finish, but little evidence of progress in design. A conspicuous exception was, of course, the great stationary telescope which the author considers an exhibition of great mechanical skill. The photographic lenses only were completed—in fact the final corrections had not been made on them—and the great 49-inch disks for the visual lenses were shown as a separate exhibit by the maker, Mons. Para-Mantois, from whose establishment have come the glass disks for the objectives of, we believe, all the great telescopes in existence. This the author speaks of as "an exhibit of unequaled merit." The author does not consider the success of this innovation in telescope construction to be assured as yet.

The German instruments are named as those which attracted the widest attention. In addition to astronomical instruments proper, the German exhibit contained among other things a super-refined weighing balance. The instrument was covered by an air-tight copper bell from which the air is to be exhausted. To avoid disturbance due to the temperature of the operator's person the instrument is operated from a distance of ten feet through long rods extending through stuffing boxes. Suitable windows are placed in the bell, which contains thermometers and a hygrometer. Another instrument of refined accuracy in this department was a horizontal recording pendulum for recording seismic disturbances. Two super-refined clocks were shown by another German house, one of which was intended to be operated in a vacuum, to provide for which it was wound electrically. In the other clock an adjustment was provided whereby the pendulum weight was automatically raised by an increase in the atmospheric pressure, the retarding effect of the denser air being thus offset by the shortening of the pendulum.

Lack of space seems to have interfered badly with a proper display of American instruments of precision which were "huddled between automatic banjos, phonographs and false teeth." The Brown & & Sharpe Manufacturing Company had an adequate display of their various measuring instruments. In instruments for scientific purposes this country was represented chiefly by J. A. Brashear and Warner & Swasey. Mr. Brashear showed among other things test planes with surfaces parallel to within .00001 inch, speculum metal plates with diffraction gratings ruled on them by Dr. Rowland's ruling engine and containing 15,000 lines per inch and spectroscopes of novel design and the highest grade of workmanship. A 12-inch telescope by Warner & Swasey contained many points of departure from conventional designs, and smaller instruments having divided circles of greater accuracy than any before made attracted much attention.

A highly interesting recording telephone came from Denmark. With this instrument the speaker at the far end of the line may have his words recorded at the receiving end if the party to whom he desires to speak is absent to be again given out in spoken words when wanted. The record is made by transversely magnetizing a steel wire to varying degrees of intensity along its length by the current due to the spoken words. Demagnetizing the wire effaces the record and the same wire may be used an indefinite number of times.

The French section contained many historical exhibits showing the beginnings of precision work.

Mr. Reed presented his paper extemporaneously in a very graceful and interesting manner, and the members showed their appreciation of it by a generous round of applause. There was, however, no discussion upon it.

Bevel-Gear Cutting Machines at Paris.

BY F. J. MILLER.

In this paper the author has merely gathered together the descriptive matter that he for the most part has prepared for the "American Machinist" readers, and which has appeared in our columns as part of the record of the machine tools shown at the Paris Exposition. The paper illustrates and describes the Bouhey, Oerlikon, Monneret, Smith & Coventry or Roby-Smith, Gleason and the Rice machines.

The president in calling for discussion upon this paper asked Mr. Swasey to express some opinion about it or upon the general subject of bevel gear generating machinery, and in response Mr. Swasey remarked that the ground seemed to be so thoroughly covered by the paper as to leave little room for additional remarks; but he mentioned the fact of the great variation in workmanship observed upon the machines in this class exhibited at Paris, saying that while in the case of some of them the workmanship was all that could be desired, in other cases it was so poor that it seemed to him impossible that the results contemplated by the theory of the machine could be attained by it in practice.

The Locomotive Exhibits at the Paris Exhibition of 1900.

BY STORM BULL.

This is the longest paper presented at the meeting, and although the author disclaims special acquaintance with locomotive work—the paper having been prepared at the request of the secretary—it is certainly a very discriminating and competent presentation of the facts. Outline diagrams of nearly all and a table of the leading dimensions of all the locomotives exhibited are shown and these are supplemented by about twenty-five full-page and folding plates giving plans, sections and elevations of many of the leading engines. Several engravings from photographs are also included.

The exhibits from this country were entirely inadequate, there being but three American engines—all of the Baldwin make—in the exhibition, against sixty-three from all other countries, of which sixteen came from France and fourteen from Germany.

Among the leading points with which the author was impressed were the increased size of the European locomotives, their superior finish as compared with our own and the prominence of the compound locomotive—fully one-half of all the engines exhibited being compound. In the matter of finish the Swiss engines are given the palm. In view of the desire of foreign peoples for finely finished engines the author considers that American builders should pay greater attention to this feature if they wish to increase their export trade.

The author was particularly surprised at the Russian exhibits which exhibited a good deal of originality. The German exhibits, taken as a whole, are spoken of as "perhaps the most instructive of all." The German exhibitors—numbering nine in all—worked in co-operation and arranged beforehand what each should exhibit in order to assure a representative selection of German engines.

Prof. Goss, in discussing this paper, referred particularly to the locomotives of the Northern Railway of France, saying that while they were much more complicated than American locomotives, it was questionable whether they did not present advantages which were important. He said that simplicity had been the ruling principle in American locomotive designing, and while he believed this was right, yet it was a question as to what degree of complexity is allowable. The engine referred to is really four complete engines as against two in ordinary American practice, and while this greatly increased the number of parts, it yet possessed certain advantages, among which are that it is very well balanced, two of the cylinders being connected to the forward axle, while the other two are connected to the rear axle, these being, by means of side rods, kept in positions 180 degrees apart, so that the reciprocating and rotative parts balanced each other; second, there was a much better distribution of power throughout the frame of the engine, its application to the frame being distributed throughout a greater length, thus doing away with what is proving to be a serious trouble in American locomotive design owing to the rapidly increasing demands for power development secured by higher steam pressures and larger cylinder diameters. He thought that while the number of parts in the engine was increased, yet it was not unlikely that the better distribution of stresses referred to would counterbalance this consideration so far as repairs and maintenance are concerned; thus endorsing what was said by the designer of the engine referred to in his paper presented before the Institution of Mechanical Engineers of Great Britain in June, 1900, which paper was published in abstract by the "American Machinist" last July. Discussion was called for at this point upon Mr. Hunt's paper, but as no one was inclined to discuss it the next paper on the program was presented.

A Method of Filing and Indexing Engineering Literature, Notes, Data, Etc.

BY GEO. H. MARR.

This paper describes Dean's document file, which has already found a place in our columns, and which the author uses for filing clippings. For notes he uses the Morehouse note book, which has detachable leaves and indexes whereby obsolete matter may be removed entirely and the less frequently used material may be transferred to the clipping file.

This paper was discussed by several of the members. Mr. Smith believed that no fixed rules could be given for such work. He had found the envelope system unsatisfactory, mainly for the reason that where one is specially interested in a given subject he is apt to find that the envelopes devoted to that subject soon become filled and that there must then be a re-distribution of the matter contained in them, with a rewriting of the indexing that has been done upon the outside of the envelopes or elsewhere; he favored a system by which each clipping or article is placed in a box between properly marked cards, thus giving the system the characteristics of the card index.

Professor Breckenridge said that all schemes of indexing are poor ones, by which he meant, of course, that all are more or less unsatisfactory. He believed, however, that it would be found in the end that the conclusion of the library people was the right one, their view being that the decimal system is, all things con-

sidered, the best practicable system. He thought it should be used and it was better to make use of it with such modifications as might be necessary in special cases rather than to attempt to devise new or individual systems. At the University of Illinois, with which Professor Breckenridge is connected, he said that students had been assigned to make upon the Dewey system indexes of various subjects or of various technical journals and that under proper directions these indexes had proven to be very excellent in many cases, so much so that they had been taken by the Western Association of Engineering Societies and were on file in its offices in Chicago.

Thursday afternoon was spent in a trolley excursion to and a drive about Waukesha, which was very much enjoyed, as was also the social reunion held at the main dining room of the hotel in the evening, the ladies being present.

FRIDAY MORNING SESSION.

Professional papers were presented and discussed, the first being

A Filtration Plant at Albany, N. Y.

BY W. O. WEBBER.

This paper seems to be misnamed. It contains a very brief description of the filtration plant, but the most of it relates to a test of the pumping plant connected therewith. The pump is a centrifugal, and the duty obtained was 44,574,801 foot-pounds per 1,000 pounds of feed water and 40,610,000 foot-pounds per 100 pounds of dry coal.

Mr. E. T. Adams, in discussing this paper, commented upon the fact that a very low efficiency had been obtained, and gave instances of similar work being performed by different motors and by which an efficiency about three times as great was obtained. He disclaimed any intention of criticising the test, but thought it was curious that a motor so illy adapted to the work to be done should have been used when, so far as he could see, there was no reason for it.

Test of an Hydraulic Air Compressor.

BY WM. O. WEBBER.

The test here recorded relates to a Taylor compressor at Magog, P. Q., Canada, of which an account appears in our issue December 3, 1896. The compressor consists essentially of a shaft sunk in the earth with a penstock extending to its bottom, this penstock carrying a suds of air and water, the former being compressed as it goes down and separated from the water in a bell at the bottom—the air being then carried to the surface by a pipe while the water rises in the well around the penstock and finally escapes to the tail race at a level below the head race. The installation here tested is the first of its kind, though another is in use in British Columbia and three more are under construction.

The compressor was tested in its original condition and also with changes made to increase the area of the air inlet—these changes being made, we imagine, in order to obtain data for future use in laying out plants. The supply of water was also varied in order to obtain the results with different ratios of air and water supply. Under these different conditions the efficiency of the plant was found to vary between 55.2 and 70.7 per cent.

A striking feature of the performance of the plant is the low percentage of moisture in the air discharged from it, which ranged between 29 and 44 per cent. of saturation, the percentage being uniformly lower in the discharged air than in the external atmosphere.

Additional interest would have been given to the paper had it contained a description of the apparatus used for measuring the air. This is described as "air meters, properly calibrated."

Prof. Thurston sent in a written discussion of this paper, in which he said that his first impression had been unfavorable to the method shown, but upon further examination and consideration of the remarkable efficiencies obtained, he had concluded that in many cases it would prove more economical on the whole than compressors of the orthodox form. He said that of course in all hydraulic work the nature of the ground and the peculiar conditions of the installation would very much affect the cost, and would determine, therefore, the best plan of procedure, but that he was convinced that under many sets of conditions the plan described in the paper would be found very advantageous.

The Bardwell Votometer.

BY A. FRANCIS BARDWELL, C. E., AND JAMES HAMILTON.

This paper first describes the distinguishing features of the Australian ballot, then the means by which the security aimed at by it has been nullified either by carelessness, ignorance or criminal intent and finally describes in detail a machine for voting, in using which the voter simply takes a key given him by the election inspector, goes behind a screen where he is secure from observation, inserts the key in the keyhole corresponding to the party or candidate he wishes to vote for, gives it one half-turn and thus registers his vote. The means by which he can, and in fact must, do just this precise thing and nothing more are described in full and the machine seems to very fully provide for the casting and registration of a legal vote and to prevent the possibility of fraud or the accidental or intentional disfranchisement of an elector.

In presenting this paper the secretary remarked that it had been called out as a result of some circulars that had been sent to the membership requesting, among other things, suggestions as to subjects for discussion before the society, or, in other words, asking members to name subjects on which they would like to have papers presented. This subject of voting machines led all others, and the paper had therefore been prepared by special request.

Prof. Thurston, who is a member of the New York State Commission appointed to investigate the subject of voting machines, sent in a written discussion, in which he spoke in the highest terms of voting machines generally, expressing the opinion that they were bound to produce very important effects upon the character of elections, tending strongly toward purity and honesty, and that he believed practically all the mechanical difficulties had been thoroughly surmounted. He believed such provision had been made that no municipality or State could be hampered by a monopoly of such machines, but that the way was open for the inventor of any new or meritorious machine for the purpose to secure attention and the adoption of this device upon its merits. He believed it the duty of the American Society of Mechanical Engineers and its members to advance the use of voting machines in every possible way, not only in their capacity as engineers, but also as citizens interested in the welfare of their country.

A member who evidently had been considerably interested in the political affairs of the town in which he lived, expressed some doubt as to the successful working of such a machine in his locality, and asked several questions about it, these questions confirming his preliminary statement to the effect that he had given the subject of voting machines little attention and had not read the paper.

Some Experiments on Ball Bearings.

BY C. H. BENJAMIN.

The author begins his paper by referring to experiments on the crushing strength of balls, saying that in service balls do not fail in this way and that figures for crushing strength are very misleading when used as a basis for designing ball bearings.

The experiments here recorded aim to show the behavior of balls under various speeds and pressures. A vertical pulley, fitted with hardened thrust blocks and a ball bearing at each end, was arranged to be placed in a testing machine where it could be subjected to a measured load and driven through a transmission dynamometer. A single ring of balls, kept in position by loose retaining rings, was used in most of the experiments, though balls tracking in different circles were also tried. Results are recorded with pressures ranging between 500 and 4,000 pounds load, the usual speed being about 260 revolutions per minute. The balls used were of $\frac{1}{4}$ and $\frac{3}{8}$ inch diameter, the number in a bearing ranging between fifteen and twenty-eight, with one case of seventy-nine balls filling the entire space between the plates. The worthlessness of the tests of the compression strength of

balls as a guide for ball-bearing practice is shown by the fact that the extreme load which a bearing was found to be capable of enduring was only about one-sixtieth of the combined ultimate compression strength, or one-twelfth of the safe working strength of the balls.

Some unlooked-for results were obtained in the experiments. Under fairly heavy loads considerable radial pressure was developed, sufficient to make indentations or cut a continuous groove in the retaining ring, according as it was or was not allowed to turn freely. In order to remedy this, the plates were made concave, but this was found to make matters worse. Convex plates were then tried, with decided improvement, if the convexity were not too great, the limiting angle being at about two degrees between the plates, or one degree for each plate.

Prof. Thomas Gray sent in a written discussion with sketch of a device he had employed in testing ball thrust bearings and giving the results of his experiments. He stated that ⅜ steel balls running on hardened steel surfaces were invariably injured at loads about 40 pounds per ball, and he had noticed also that whether the surfaces upon which the balls ran were flat or conical, the balls themselves tended always to retain the same axis of rotation.

C. W. Hunt, being asked for his views upon the paper, said that his experience with ball bearings had been confined to their use for light loads and he believed that such use was the only practicable one for them and that wherever the load caused any material departure from sphericity of the balls or any deterioration of the integrity of the surfaces upon which they rolled, such bearings could not be satisfactory.

A Pulley Press Valve.

BY FRANCIS H. STILLMAN.

The title of this paper is somewhat misleading, as it concerns not a single valve but an arrangement of a series of valves which, as the paper says, "is believed to be one of the most elaborate ever used to operate the motions of a single hydraulic press." The "single" hydraulic press in this case was built for forming the half rims of the American Pulley Company's all-steel pulleys, invented by the late Thos. Corscaden and described in our columns in 1897. The press had cylinders working in six directions, with, in addition, automatically operated cylinders for drawing the rams back, the cycle of operations controlled by the valve being completed in from one-quarter to one-third of a minute. The paper enumerates and specifies the functions of twelve different valves which are brought into operation. Different pressures also are used for the different rams, there being a normal accumulator service of 150 pounds and two intensifiers which give one of them 1,000 pounds and the other 2,000 to 3,000 pounds, as required. While the "valve" as a whole is complicated, the details of it are simple.

There was no discussion.

Determination of Flywheels to Keep the Angular Variation of an Engine Within a Fixed Limit.

BY J. I. ASTROM.

This is a complete solution of the flywheel problem in which all the factors are taken into account. It is partly graphical but chiefly mathematical. Effort and load curves are determined and superimposed, and by a comparison of the two the problem is solved. The most striking fact of the paper is perhaps the concluding portion, in which the result of changes in the angle between the cranks of compound engines from the usual one of 90 degrees is shown. In one case this angle is made 144 degrees and in another 120 degrees, and with marked improvement in both cases. The subject is of increasing importance in connection with engines driving certain classes of electrical machinery, and its re-examination is therefore timely. Several tables are given to facilitate calculations.

In discussing this paper Prof. Chamberlain described and, by a sketch upon the blackboard, illustrated a device that had been used at the Lewis Institute, with which he is connected, and by which the pulley flywheel of the engine had been used as part of a chronograph. This instrument consisted of a small shaft placed in front of the flywheel at right angles to its face and carrying at the end nearest the flywheel a small bent spring having a sharp point touching the face of the wheel, the point being slightly eccentric with the shaft. The face of the wheel was covered with whitewash and the small shaft carrying the spring being driven at a high speed by a motor, and the motor and the shaft being both mounted upon a bar, which was moved slowly across the face of the wheel, caused lines to be drawn in the whitewash, forming at slow speeds of the wheel loops and at higher speeds epicyclic curves, the distance from the terminations of these curves enabling him to determine the speed of the wheel, and showing graphically any variations in that speed that might occur. It was objected to by some of the members that the belt by which the small shaft was driven from the dynamo might have slipped or otherwise failed to produce an exactly uniform rotation, and that the results therefore might not have been as accurate as the Professor supposed they were. Prof. Chamberlain called attention, however, to the fact that a series of such lines was drawn across the face of the wheel and that had any erratic action taken place it would have been clearly shown by the lines themselves, and he thought that where irregularities or variations in the length of the loops occurred at regular intervals entirely across the face of the wheel it was very good evidence that no slip of the belt had taken place, aside from the fact that the work done by the belt was so very light that it probably could not have slipped.

Several members expressed doubts as to whether any mechanical device could give accurate results in this work and described electrical devices of various kinds for accomplishing this. Finally Mr. A. K. Mansfield, chief engineer of the Buckeye Engine Company, said that he could not see how the paper improved the situation, for the man who must make flywheels or design them. He thought that the only way to proportion flywheels for a given service was to observe whether a flywheel produced sufficient regularity of motion, and if it did not, then to make it heavier. He said he had been through all these matters of intricate calculations for flywheel weights; he admired their ingenuity very much and thought it was a very fine thing to understand them and to be able to manipulate the intricate formulas and diagrams employed; but, after all, in their practice he found that a very simple formula answered all practical purposes in proportioning flywheels. This formula includes a constant which answers for all ordinary purposes. "Now," he said, "when we have a special case, we alter this constant to suit the conditions as nearly as we can in accordance with our judgment; and as a matter of fact, after we have the flywheel figured very carefully to meet the requirements as nearly as possible, then," said he, "we double the weight of the wheel merely to suit the customer"—a statement that was received with much laughter.

A Special Form of Boring and Facing Machine.

BY WALTER S. RUSSELL.

This must be considered an inadequate and unsatisfactory presentation of a special machine tool presumably interesting and serviceable. No drawings are given nor anything like a clear description. One half-tone shows the machine mostly concealed by a large cylinder, the flange of which it is facing. The machine consists es entially of a cylindrical frame and a large revolving plate carrying four slides and cutter holders. The work to be faced must be large enough to sit over the cylindrical portion of the frame, and a large projecting flange all around serves for support and for bolting. Although the machine weighs 34,000 pounds it is called a portable machine, as it is self-contained and may be placed upon temporary blocking wherever convenient. Although called a boring machine, from the description the inference is fairly drawn that it does not bore but is only for facing.

There was no discussion.

The afternoon was devoted to a drive about the city in carriages, the first visit being to the Soldiers' Home, and after that to the Sacred Heart Sanitarium, where the Swedish machines for mechanical massage were inspected with great in-

terest. This is said to be the most complete equipment of such machinery in this country, and it is doubtful if such an outfit has ever before been inspected by a body of men more generally interested or more thoroughly appreciative of its mechanical points.

FRIDAY EVENING'S SESSION.

The first paper of the session was

Efficiency Tests of a One-Hundred-and-Twenty-Five-Horse-Power Gas Engine.

BY C. H. ROBERTSON.

The tests here reported are supplemental to those reported by the author at the December, 1899, meeting of the society. The engine under test was of the Westinghouse make, with natural gas as fuel. In the tests before reported the engine was in its running condition, but before these tests were made it was thoroughly overhauled by its makers.

The tests are very complete and include the speed regulation, not only as shown by a revolution counter, but the momentary fluctuations as well—a very ingenious tuning-fork chronograph having been made for this purpose. The heating value of the gas was investigated and the usual efficiencies and the heat balance were calculated. The thermal efficiency of the engine based on brake and indicated horsepower show as maxima 22.56 and 25.8 per cent. respectively. The momentary fluctuation of speed was only 1½ per cent. above and below the normal.

Mr. Scheffler asked for an explanation of the very great variation in friction load of the engine, calling attention to the fact that a variation of 30 per cent. in friction load had been obtained during the test. He thought this indicated some inaccuracy in the test and did not see how the general results supposed to have been attained could be depended upon. The author replied that he would account for this variation in the same way that such variations were accounted for in steam engine tests; that is, he would not account for them at all. He said that such variations in the figures representing friction loads always manifested themselves, so far as his experience had gone, in tests of engines of any kind, whether steam or gas, and that about one hundred tests of steam engines in which he had taken part had all shown the same or similar variations.

A Method of Preparing and Baling Cotton in Round Bales of Uniform Lap.

BY J. R. FORDYCE.

This paper is a description of the new method of baling cotton in round bales, and compares the advantages of that method with the older one in which the bales are square. The new method, if its claims can be substantiated, is of almost revolutionary importance, as it is estimated that $40,000,000 per annum can be saved to the South by its general adoption. The air is more thoroughly pressed out of the round bale and the fire risk is correspondingly reduced, while the greater density of the round bale reduces transportation and warehouse costs. The reduction in ocean freight from these combined causes is stated to be 25 per cent. There are also important savings due to reduced tare weight and to better cleaning and protection of the bale and to reduced labor in preparing the cotton at the mill.

The paper describes the process and machinery with, we judge, entire clearness to those acquainted with the technology of the cotton industry, although the liberal use of technical terms peculiar to that industry is somewhat confusing to others. The machine and method are the results of six years of study and work on the part of the author. At the conclusion of his paper he states that "the system from a mechanical standpoint is a success. From a commercial standpoint it is not yet fully established, but the prospects in that direction are very bright."

There was no discussion.

Protection of Ferric Structures.

BY M. P. WOOD.

The subject of this paper is one of the highest importance, and it has been a special study of the writer for a number of years, no less than four papers upon the same general topic having been previously contributed by him to the Transactions of the society. More than fifty pages of additional information and discussion are here collected. The conclusions arrived at and the recommendations which the reader would naturally expect to find in a paper of this character are here not easily separable. Most of the paints employed seem to be of little use as permanent rust preventives; the best reports in the paper seem to all have to do with one special brand of graphite paint. Varnishes, as distinct from paints, seem to give better results. Perhaps the clearest statements in the paper are that "the nearer any protective coating approximates an enamel or varnish, generally the more durable it will be," and "the coming ferric protection coating will probably be a true varnish with a carbon or graphite pigment."

Geo. D. Long, of the Jos. Dixon Crucible Company, had by request sent in a written discussion of this paper in which discussion he seemed to take issue with about everything that had been said in the paper regarding the differences between granular and flake graphite. He compared the behavior of granular with flake graphite by referring to the action of a load of granite blocks dropped upon the street and a load of pieces of slate dropped in the same way, calling attention to the fact that while the granite blocks would lie in every imaginable shape with interstices equalling, probably, in bulk, the space occupied by the stones themselves, the pieces of slate would probably, for the most part, lie in planes parallel with the surfaces upon which they rested. He believed that flake graphite, when used as a paint pigment, behaved much the same way under the brush—that is, that each flake assumed a position parallel to the surface upon which the paint was spread and thus formed a much better coating than was possible with granular graphite.

Prof. D. C. Jackson, in discussing the paper, mentioned the electrolytic action producing corrosion on metal submitted to strains and said that experiments conducted by himself had shown this action in the most marked manner, and particularly that metals which changed their characteristics when submitted to strains were most affected by electrolytic action. He had observed that members of the same structure composed of precisely the same metals, some of them placed under strain while others were unstrained, showed this effect quite plainly, the strained members being much affected, while the unstrained ones were not affected at all. It had been shown also by experiments that in tension tests about one-half the energy expended upon the specimen went to produce molecular changes, while the other half was expended in heating the specimen.

An Improved Type of Ingot-Heating Furnace.

BY F. H. DANIELS.

The furnace described in this paper is called a vertical furnace, that term applying, however, to the position of the ingots in the furnace and not to the form of the furnace itself, which is horizontal. The furnace is fired at one end and the ingots are charged at the other. They stand nearly vertical, inclining alternately to the right and left. They rest at the bottom and at the sides near the top against water cooled pipes and are pushed into the furnace by an electric pusher. As they approach the hot end they increase in heat and on arriving at that end are removed through the top of the furnace.

The advantages claimed for the furnace are low cost, compactness, accessibility, uniform and gradual heating of the ingots, economy of heat, absence of hydraulic appliances, small production of scale and reduced segregation in the ingot. In particular the electrical pusher is considered superior to similar hydraulic appliances.

As no one else offered to discuss this paper, the secretary suggested that the society would probably be glad to hear from its president, and, in responding, President Wellman said that the paper described a furnace which is now working in Worcester, and that it was almost the first attempt to heat ingots in a vertical position. He believed that it was an important improvement and would result in considerable economy of fuel. He referred to the general use of continuous heating furnaces in rolling mills and said that they used hardly more than half the fuel required for regenerative furnaces.

Ingots designed for rolling steel rails had been heated in the vertical position for some time past, owing to difficulties or uncertainties that had been encountered in heating them in the horizontal position, and this had been done in what is called the vertical soaking pit furnace, which, however, was very uneconomical in fuel.

This closed the program of professional papers, and the secretary announced that a paper which was to have been read by H. H. Suplee on "The Entertainment of the Visiting Engineers in Europe in 1900" had not been prepared in time by Mr. Suplee because he had been engaged in other affairs of considerable importance to himself, having, in fact, been recently married. The secretary stated, however, that the paper would be completed and prepared in time for incorporation in the Transactions of the society.

Under the head of Business Affairs, the secretary announced that the council had considered the advisability of increasing the annual dues for full members from fifteen dollars to twenty-five dollars; for Associates and Juniors, from ten dollars to fifteen dollars, and of life membership from $200 to $350. The council looked upon this proposition with favor and therefore notice was given in accordance with the constitution that a motion to amend in accordance with this idea would be submitted at the next meeting—that is, the fall meeting to be held in New York. No explanation of the proposed increase of dues was officially given, but it it understood that the principal incentive to such increase is the fact that it is becoming apparent that the society must have a new house or building in New York, the one now owned by the society having become entirely inadequate to its needs during the annual meetings.

After this the usual resolutions of thanks were adopted by the society, specially thanking the very efficient local committee, the ladies' entertainment committee and the various manufacturers of the city whose establishments had been thrown open to the visiting engineers; the general sentiment being that the Milwaukee convention had completely met the expectations of those who had prophesied that it would be a very successful and pleasant meeting.

Some New Things.

A STEAM OR AIR MOTOR WITH OSCILLATING CYLINDERS.

The accompanying cuts, from a recently issued United States patent, may be taken as embodying a study or suggestion toward the production of a simple and compact motor to be operated by compressed air or steam for any isolated service, as for hoisting, for the operating of individual machine tools, or similar purposes. Fig. 1 shows the motor complete. It has three lugs or feet at the back of it, by which it may be fastened against a wall. In this position the driving shaft is horizontal. If the motor was placed with its feet secured to a horizontal surface the driving shaft would be vertical. The chain wheel shown in front of the motor is for operating a reversing valve. The vertical arm hanging central in front, with a weight on the lower end, brings the reversing shaft to its central position, when the engine will not run in either direction. Fig. 2 is an end view of the motor with a portion broken away, showing the trunnions of one of the cylinders. Removing the valve chest, the two cover plates and all appurtenances, we have Fig. 3, which shows the interior of the motor case with the two cylinders in position. The normal or central positions of the cylinders are at right angles to each other, and the piston rods of both attach to the same crank-pin.

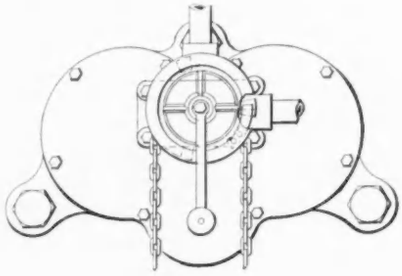


Fig. 1

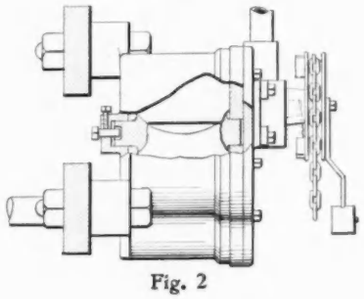


Fig. 2

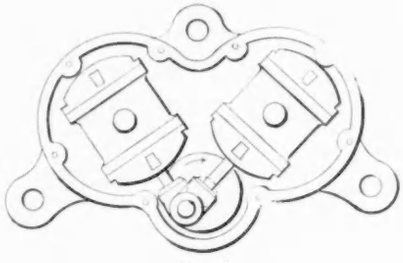


Fig. 3

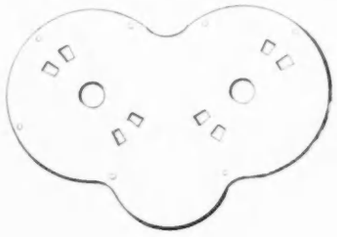


Fig. 4

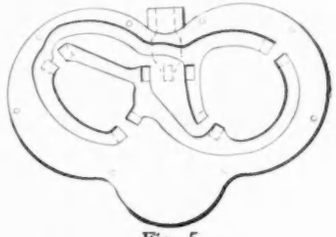


Fig. 5

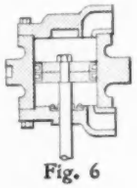


Fig. 6

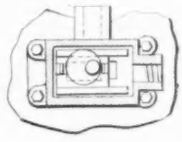


Fig. 7

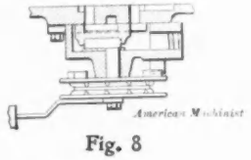


Fig. 8

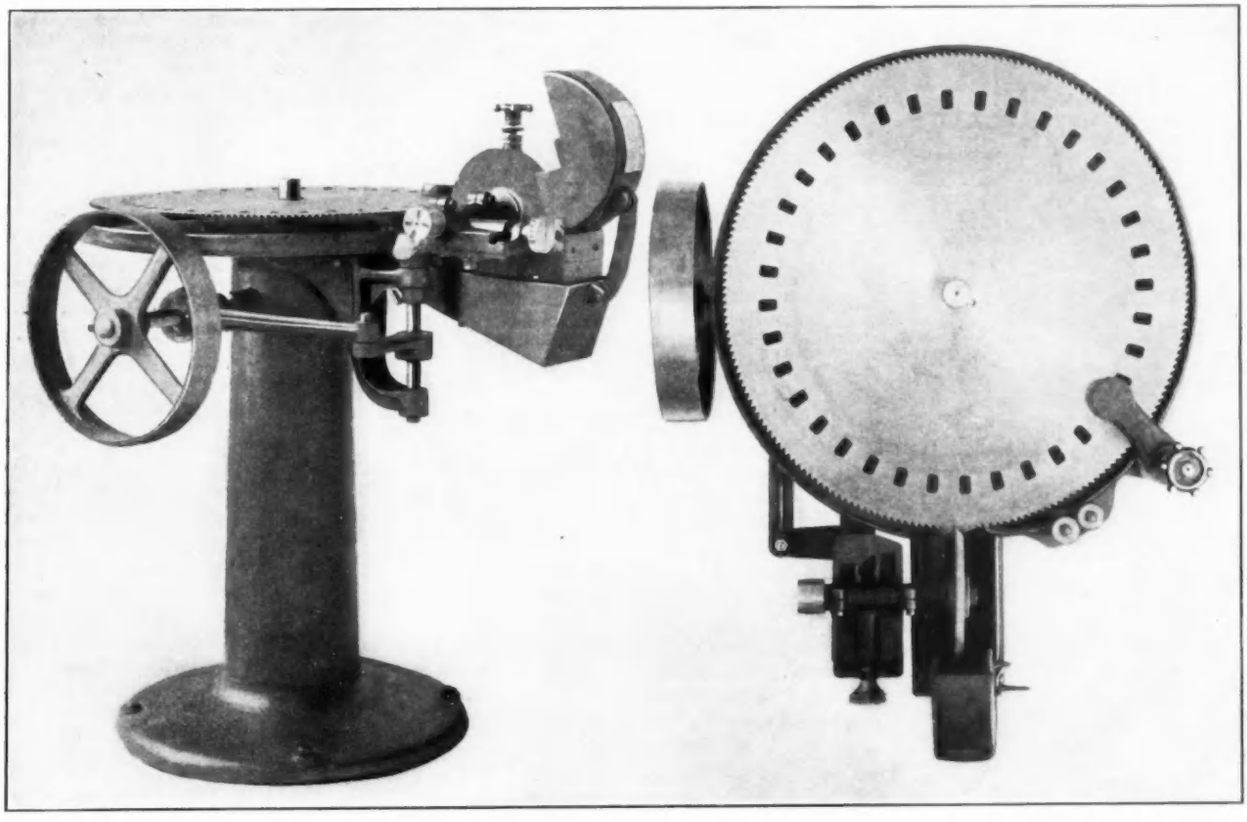
AN AIR OR STEAM MOTOR WITH OSCILLATING CYLINDERS.

Fig. 6 is a vertical section of one of the cylinders. On each end of each cylinder (see Fig. 3) is a flat face slightly overhanging the largest diameter of the cylinder, with a single port communicating with that end of the cylinder. The cover or plate, Fig. 4, is first placed over the case or shell, and the flat cylinder faces are made to work close against the inner surface of this plate, being held up to this face by central screws against the back trunnions. When either cylinder is in line with the crank-shaft centers, the ports at both ends are covered by the plate, Fig. 4. As the shaft turns the cylinder oscillates, and then the ports communicate with ports in the plate, one end with the compressed air or steam and the other with the exhaust, this communication continuing during one-half of a revolution, when for the other half the connections of supply and exhaust are reversed. This is not an ideal valve motion, but the engine will go. The addition of plate Fig. 5 to Fig. 4 completes the necessary passages of transmission. This plate is shown reversed, the inside, or the side which comes in contact with the plate Fig. 4 being shown. On this face are two channels of very irregular shape. These channels do not go through this plate, but only perhaps half way through it, thus forming a passage for the operating fluid to four ports in the four ends of the two cylinders. Each of these crooked channels has one port which goes through the plate; these two ports, with a central port indicated by dotted lines, are covered on the outside by a chest with a common slide valve which is moved back and forth by a cam or eccentric on the inner end of the chain-wheel shaft. The steam or compressed air enters the chest by the horizontal pipe, Fig. 1, and the exhaust is by the central passage communicating with

the central vertical pipe. It will be seen that by moving the slide valve from one end to the other, the pressure and exhaust are reversed and the motion of the motor is also reversed. A throttle valve anywhere in the supply pipe is then all that is required to completely control the motor.

A COLD-SAW GRINDING MACHINE.

The extensive and increasing use of the cold saw for cutting iron and steel, and the necessity of keeping the saw sharp as an essential condition of high efficiency, has entailed a demand for a special saw grinder, which demand seems to be fully met and satisfied in the machine here illustrated. A side view and a top view of the machine are given, with a saw in position for grinding.



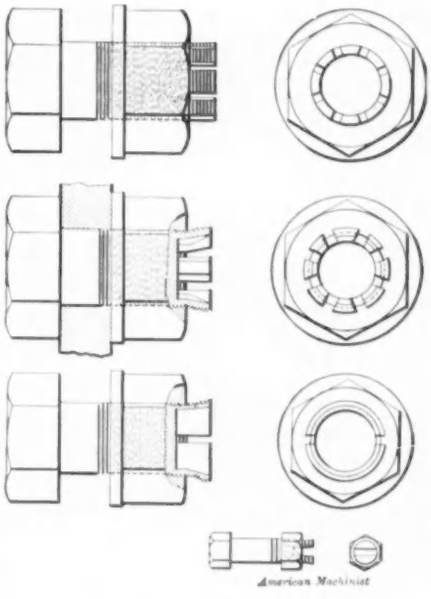
A COLD-SAW GRINDING MACHINE.

The countershaft furnished with the machine has a large driving pulley and a small one, the large pulley driving the emery wheel direct, while the small pulley is belted to the large pulley on the side of the machine, from which the feed and the supplementary movements of the machine are derived.

The machine is either a dry or a wet grinder—usually the latter. As the hood is swung down over the wheel, the water-pan is raised and the wheel then runs in water. Raising the hood lowers the pan again and the wheel is dry. The relative weights and leverages are so arranged that either position is retained without attention. The saw is mounted horizontally on a vertical stud, which has an adjustment to suit any diameter of saw up to the size of the drip-pan. The saw is rotated in front of the grinding wheel by a friction arm reaching in over it, with another directly under it, the friction being readily adjusted as required. These clamping friction arms have an adjustable throw, according to the size of the tooth, and the movement is justified by a double-stop pawl, with hand adjustment and renewable tips, to hold the tooth to be ground in the desired position, making it possible to grind teeth of any pitch or shape. The wheel, mounted on a pivoted carriage, has a quick to-and-fro movement which distributes the wear and covers the entire tooth surface to be ground. In addition to the adjustments provided for the saw diameter and the throw of the friction levers, a third is provided in a hand-wheel by which the grinding carriage may be advanced, thus avoiding changing the position of the saw for "gumming" the teeth, or for a second cut around, and accurately regulating the depth of the cut. This grinder is made in two sizes, for saws from 12½ to 36 inches in diameter. The agent for it is J. R. Vandyck, 136 Liberty street, New York.

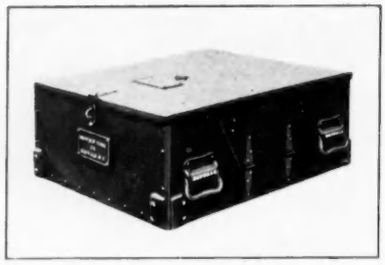
EXPANDING LOCK BOLTS.

The accompanying illustrations show a system of lock bolts. The locking device is the hollowed-out end of the bolt, which is slit lengthwise in such a way as to form a number of teeth, which may be bent slightly outward after the nut is in place, to prevent its unscrewing. The teeth may be more or less numerous, according to the size of a bolt, allowing them to be expanded with reasonable facility by driving in a punch, and bent inward again by unscrewing the nut with a strong wrench when it is desired to remove it. For small bolts a simple slot, a trifle wedge-shaped, suffices for locking purposes. It is believed that bolts of this system could be forged at little greater expense than the



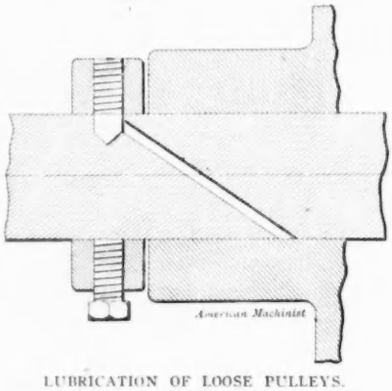
EXPANDING LOCK BOLTS.

ordinary kind. The system is that of Georges Lacroix. The illustrations are reproduced from the "Chronique Industrielle," Paris.



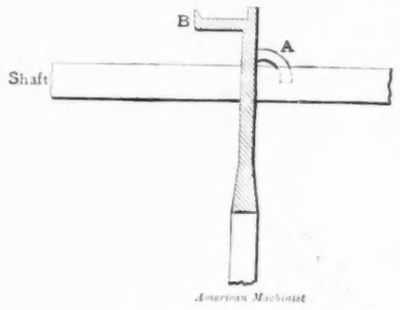
PORTABLE KNOCK-DOWN FORGE.

The Buffalo Forge Company, Buffalo, N. Y., has devised a form of portable forge, shown in the accompanying photographs giving a view of the forge closed for transportation and open for work. The photographs seem to tell the whole story and to make further explanation unnecessary. It is readily seen how the legs, the blower and other parts are detached from the frame of the forge, and when detached this frame holds all these parts, so that when the lid is closed the box is ready for transportation. The forge is especially well adapted for army use or for structural steel workers, bridge builders, etc.



LUBRICATION OF LOOSE PULLEYS.

The usual plan of putting the oil hole for a loose pulley in the hub has the disadvantage that there is no chance to oil the pulley when the line shaft is turning and the machine is not running, which is just the time that there is most need of it. W. A. Bright is said to have had success in reversing the common method by drilling the oil hole through the shaft as shown in the illustration. This hole opens opposite one in the collar that holds the pulley in place and into this collar the lubricator cup, if any, is screwed.



PORTABLE BELT HOOK.

The accompanying cut shows a device intended to prevent the workman from being drawn up and dashed to pieces by a loose belt which he may be lacing. It is an iron hook for lifting the belt from the shaft. The Inspector of Factories in England recommends the use of hooks to lift the belts from overhead pulleys; but as a great many of these would be required to equip a large establishment with one for each pulley, he has approved this portable hook, mounted on a pole. We reproduce the illustration from the "Iron and Coal Trades Review."

How Discipline Fought the Monitor.

"Thirty-nine years ago, when night shut down over those waters there, it left a fleet of great wooden hulks helplessly at the mercy of one ship of new construction, and that one ship was confidently awaiting the rising of the sun to go calmly on and complete the total destruction of that entire fleet. There was no hope for them. Nothing foreseen could hinder. When the morning sun peeped above the horizon the scene was hardly changed. One more craft had appeared during the night, but it was a very insignificant affair, and not at all noticeable. Without a nautical line, a direct departure from all the traditions of the navy, her officers even could not overcome the traditions of a lifetime, and loathed and despised her and had no confidence in her. The brave Worden himself, he whose place in history was secured by that one craft and by his action on that one occasion, is entitled to all the more glory from the fact that he obeyed orders and went into what seemed to him to be a hopeless and useless sacrifice. When that shot struck the slot in the turret, through which he was looking, dazed, stunned and blinded he reeled back, and, thinking the whole turret was knocked off and his boat destroyed, he called out to his companion (from whom I afterwards had it direct), 'There's the end of your d—d experiment.'

"It was an experiment, and it was not his own. He had not the enthusiasm that comes of being an author. He did not believe in it at any time. This unseemly raft of a craft, without a line or trait approvable to nautical eyes, looked to him a veritable floating coffin, and not likely to remain long buoyant at that; but he was ordered to go and fight it, and he obeyed orders and made his place in history. He is all the more a hero for his unbelief, and that he believed his mission hopeless and his own destruction certain, and yet went in and obediently executed the orders given him."—"Gates" in the "Clay Worker."

Better than Imitation.

It has been of late frequently stated—and with much truth—that, as regards certain points of workshop practice, our friends in the United States are in advance of the mechanical engineers of this country, and it has been strongly urged that we should adopt American methods here. Such advice is very well in its way, but those who offer it fail, perhaps, to realize that its acceptance in a liberal sense would, at best, but place us on the level of those we imitated. What is really wanted, if we are to maintain our national supremacy as mechanical engineers, is something more than this. Let us, by all means, study most carefully not only American methods, but those of Germany, Switzerland, or any other country which is advancing in mechanical engineering work; and then, aided by such acquired knowledge combined with our own long and varied experience, let us do our best to evolve still more improved methods of working, and—what is equally important—let us not hesitate to abandon methods which, however well they may have answered in their time, are now out of date. It cannot be too often repeated that he who copies is always behind him who originates, and it is the first in the race who wins. The time has long passed when the manufacturers of any one nationality could afford to rest on their laurels won in commercial competition. Nowadays, there is no standing still, and a nation must progress or fall back. If it desires to progress, it must work at least as hard as those who are opposed to it; and, above all, it must keep itself fully informed of all its contemporaries are doing. No policy is so fatal as that which leads a competitor to underrate or ignore the good points in the practice of those with whom he has to compete.—Address of President William H. Maw, Institution of Mechanical Engineers.

The World's Dependence Upon the Engineer.

When we remember how the developments of civilized life depend upon the products of mechanical science, it is astonishing how inadequately the ramifications of mechanical engineering practice are appreciated by the average citizen. It is only by entering into very considerable detail that the real facts of the case can be brought home to such a person, and these facts are, without doubt, very striking. They prove that, from the time we rise in the morning to the time we retire to rest, there is scarcely a moment during which we are not indebted to the mechanical engineer for our necessities and our comforts. His work pervades our very existence. It may easily be shown that there is scarcely an article we use in the production of which some mechanical device has not been employed. Our daily wants include the products of textile machinery, mining and metallurgical appliances of the most varied description, metal working machinery, machinery of various kinds for the treatment of food products—including milling machinery, sugar-making and refining machinery, agricultural machinery, and so on—paper-making and printing machinery, sewing and other machinery used in the manufacture of our wearing apparel, and numberless other mechanical devices of a minor kind. Then, again, the machinery constituting the mechanical equipment of our water works, and that of our works for lighting by gas or electricity, etc., contribute in a most important degree to our health and comfort. Moreover, the mechanical engineer, in addition to designing and constructing all this varied machinery, has to supply the motive power by which it is operated, and the tools by which both the machinery and its motors are made; while, beyond all, it is to him that we are in the main indebted for the effective working of our modern systems of transport by land and sea, and for the blessings which they confer.—ADDRESS OF WILLIAM H. MAW, Institution of Mechanical Engineers.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(17) W. J., Providence, R. I., says: In your issue No. 18, in the Questions and Answers column, when answering question No. 14 regarding the balancing of engines, you said: "If the engine is vertical and stands on a firm foundation, the result of complete counterbalance is harmful; but if it stands on a ship's deck, beneficial." Please explain this. A.—As was explained in the answer referred to, the effect of complete counterbalance is to neutralize the disturbing force in line with the piston rod, but to introduce an equal disturbing force at right angles to this. In stationary engines on good foundations the vertical force is least harmful, because it has the entire earth to resist it. The aim is always to overcome the tendency to horizontal shake, while the tendency to vertical shake does no harm, as thousands of examples testify. With an engine on a springy ship's deck the conditions are reversed, as there are here more strength and stiffness horizontally than vertically. We have never seen formulas for the weights of engines of the sizes you name, and doubt if there are any in existence.

(18) C. X. asks: How can I make a soft cast iron that can be drilled with 5-16 twist drill at 660 revolutions per minute, feed .006 inch, through a casting ¾ inch diameter and ⅝ inches long? With our present mixture about 150 holes can be drilled without sharpening the drill. By annealing about twice as many holes can be drilled. The bulk of the iron must be run into very thin hardware castings. A.—Annealing is the surest way to get soft castings. Pack the castings in iron pots with wood shavings and make the cover tight with clay. Heat to a bright red heat which will take about 12 hours and let cool for 12 hours. The pots last a long time. You can use the charcoal left in the pots for packing. To make the castings soft as they come from the mold, use soft pig irons, not necessarily high-priced irons. You can find irons in your market that make soft castings. The silicon in such castings if unannealed should be about 3 or 3.25 per cent., but you must be careful to find by trial pig irons that will make soft castings irrespective of chemical analysis. You name the irons you use. The name does not give any indication of what the iron is. If you had given the grade number it would have helped a little, but not much, because the iron may still make hard castings. Generally speaking, low carbon pig iron will make soft castings. You do not give the name of your silicon pig, and perhaps you do not know the name. You must be very sure that a silicon iron will act as a softener. If it is close grained and has low carbon it may harden instead of soften your castings. Probably you would do better to get the other irons soft and be sure that you have a good silicon iron before you use so much of it.

Technical Publication.

"Central Station Experiences." From "Power." 106 6x9-inch pages, with numerous illustrations. The Power Publishing Company, New York. Price, in stiff boards, 75 cents; in cloth, $1.

In chatty shop-talk style this book gives a narrative of the trials and tribulations of a steam engineer while learning to run an electric station. A series of complications such as are liable to arise in any electric plant put the aspiring young engineer on his mettle, and the book shows how by

(Continued on next page.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 38.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Mfg.plants,space,powers,lands. A.Ela,Boston.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Barnes lathe, No. 6, 13x45, fine condition, very little used. Address S. K., care AM. M.

Wanted—6 ft. or 8 ft. boring mill, in good condition. Materne Mfg. Co., St. Louis, Mo.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Wanted—Patternmaker's second-hand bandsaw, in good condition. Box 127, AM. MACH.

See Presses, Space 45, S. E. cor. Machy. Hall, Buffalo. Ferracute Machine Co., Bridgeton, N. J.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

We do all kinds of light experimental model and special machine work; fair prices; satisfaction guaranteed. The Alcorn Machine Co., Waltham, Mass.

Wanted—Set of working drawings for single frame steam hammer, 4 in. cylinder, 16 in. stroke; state price and particulars. Address Box 153, AMERICAN MACHINIST.

Want to correspond with parties having well-equipped machine shop, to manufacture line of patented machine tools. Address "Machine Tools," care AMERICAN MACHINIST.

Mechanical engineer, patentee well-known machinery and apparatus, 15 years' business experience, wishes Philadelphia agency for responsible company; good references. "Grant," care AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

First-class mechanical draftsman wants a position. Box 123, AMERICAN MACHINIST.

Position by machinist and toolmaker; vise or machine work; age 40; Brooklyn, N. Y. Box 161, AMERICAN MACHINIST.

Position wanted by able designer of automatic and special machinery; inventive, reliable. Box 167, AMERICAN MACHINIST.

Draftsman, young man with no practical experience, wishes position; well advanced in mechanical drawing. "Ambitious," care A. M.

Twelve years' experience draftsman and pattern shop foreman wishes position in either line. Box 184, AMERICAN MACHINIST.

Experienced pattern shop foreman and draftsman wishes to teach in trade or manual training school. Box 183, AMER. MACH.

Experienced draftsman; last 5 years machine tools and fixtures; first-class American and German references. Address Hols. Wienerstr. 1, Berlin.

Draftsman, with 10 years in drafting room, also foundry and machine shop experience, would like a change. Address M. E., care AMERICAN MACHINIST.

Expert on turret lathes wishes to change; can get up fixtures and tools for doing work rapidly; capable of taking charge. Box 174, AMERICAN MACHINIST.

(Continued on next page.)

(*Continued from preceding page.*)

the exercise of his own understanding and the timely assistance of one more expert than himself these various difficulties were overcome. The cause of each occurrence is explained in straightforward language—largely in conversation between the two men. The book contains just the information which operators of electric plants need, and in language which will amuse while it instructs.

The insane policy followed by some British manufacturers was revealed by Mr. Reeves, the Agent-General for New Zealand, at the annual dinner of the Junior Engineers. The incident was as follows: The colony wanted some locomotives, and ordered them in England of an eminent firm. The eminent firm said it would be happy to supply them with a certain pattern and a certain weight. The railway authorities thereupon pointed out that the weight was too much for the bridges, which were already constructed. The eminent firm said that they were sorry, and recommended that the bridges should be rebuilt. Mr. Reeves vouched for the truth of the story.—"Indian Engineering."

The first iron railway bridge ever built has recently been replaced by a modern and stronger structure. This bridge, entirely of cast iron, and supposed to have been designed by George Stephenson, was on the line of the Stockton & Darlington Railway. Stephenson's engine No. 1, for which this bridge was built, weighed 6½ tons, while locomotives now exceed 100 tons.

The renaissance of Southern industry is accompanied by a sense of the need of practical education and not a few agencies are already actively at work in this direction. The University of Tennessee Press, Knoxville, Tenn., has sent us a copy of the "University of Tennessee Record" containing a leading article by A. C. Lanier on "Technical Education in the South." There are other articles in the same number on "The Electric Current in Chemical Analysis," "The Polar Planimeter," "Welding of Copper," "Tests of a 30-Kilowatt Dynamo," etc. We notice that a number of the graduates are filling positions in large electrical manufactories at the North—the General Electric, Westinghouse and Western Electric.

Personal.

J. R. Giller, who has been for a number of years general foreman of the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, has resigned, owing to continuous ill health in that locality. Mr. Giller will become sales manager of the Ohio Brass Company, of Mansfield, Ohio.

Situations Wanted—Cont'd.

Wanted—Position as superintendent of machine shop, by man of 12 years' experience as such; 36 years old and with best of references. Box 168, AMERICAN MACHINIST.

Mechanical engineer, a practical mechanic, experienced in organizing and superintending manufactures, is open for position; first-class references. Address Box 123, AM. MACH.

A young mechanical engineer, with technical education and experienced in both shop and drawing room, desires position; can furnish best of references. Box 173, A. MACH.

A young, energetic and up-to-date foundry foreman desires position; familiar with molding machines and modern foundry practice; best of references. Box 172, AMER. MACH.

Mechanical engineer, practical, competent, wants to change; specialties, printing machinery, hydraulic machinery and gas and gasoline engines. Address Box 159, AM. M.

Position as superintendent; capable of handling men to a good advantage and reducing costs by labor-saving devices; will purchase interest in a reliable concern. Box 177, AMERICAN MACHINIST.

Mechanical engineer, Swede, 17 years' experience, expert on centrifugal machines, wishes employment as superintendent, foreman or draftsman; best references. G. M. A., 348 Elm st., Arlington, N. J.

Technical graduate, 29, with 7 years' practical experience, mill machinery, tools, fixtures, open July 1 for position as master mechanic or chief draftsman; best references. Box 170, AMERICAN MACHINIST.

Engineer's License.—Mechanics, engineers, firemen, electricians, etc.; 40-page pamphlet containing questions asked by Examining Board of Engineers sent free. Geo. A. Zeller, Publisher, Room 316, 18 S. 4th st., St. Louis, Mo.

Young man of good habits, varied experience in locomotive, power presses and general heavy machine practice, executive ability and all-around hustling man, desires position as general foreman or as superintendent; references. Box 182, AMERICAN MACHINIST.

Superintendent of unquestionable executive ability and broad experience, thorough mechanic, both practical and theoretical, familiar with up-to-date cost-keeping systems and shop management, at present in charge of large concern, American, age 36, will be open for engagement July 1. Address Box 175, AMERICAN MACHINIST.

Situation wanted by all-around, practical foreman blacksmith; 22 years' American, 10 English practical experience; thoroughly familiar with steam and drop hammers, case-hardening, tempering of dies, milling cutters, etc.; charge of men; reliable man for the right employer; willing to go abroad; references. Box 180, AMERICAN MACHINIST.

Help Wanted.

Wanted—Two first-class operators on Gisholt turret lathe. Box 185, AMER. MACH.

Wanted—Experienced men for responsible positions. Address James Brady, 220 Broadway, New York.

Wanted—Foreman patternmaker, experienced on valves and fittings. Address Box 155, AMERICAN MACHINIST.

Wanted—Mechanical draftsman capable of designing engine and general work. Robt. Wetherill & Co., Chester, Pa.

Wanted—First-class toolmakers and machinists; steady employment and good wages. Box 93, AMERICAN MACHINIST.

Wanted—An experienced machinist who can file punches and dies for steel or brass. Oneida Community, Ltd., Sherrill, N. Y.

Wanted—Draftsman accustomed to designing valves and hydrants; state age and wages expected. Box 156, AMERICAN MACHINIST.

Competent machinery designer, preferably experienced on presses and tools for sheet metals. Niagara Machine & Tool Works, Buffalo, N. Y.

Competent draftsman for machine shop in New York; experience in sugar machinery desired; state age, experience and salary. Box 186, AMERICAN MACHINIST.

Wanted—Lively, up-to-date foreman for general machine shop employing about 15 hands; state wages expected and experience. Box 179, AMERICAN MACHINIST.

Wanted—A1 mechanical draftsman; one experienced in elevator machinery preferred; state reference, salary, age and experience. Address Box 188, AMERICAN MACHINIST.

Wanted—Foreman for machine works, capable of handling from 40 to 50 men; must have technical education and shop experience. Address Atlanta Machine Works, Atlanta, Ga.

Wanted—Toolmakers on first-class tool and die work; steady employment to good men; no labor troubles; state experience; location, Central Pennsylvania. Address Box 171, A. M.

We invite application for machinists and molders; give references, experience and wages to start; work on steam engines and air compressors. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Patternmaker, good; one experienced on gas engines preferred; give experience in detail and state wages expected, to receive answer; permanent position. Address Box 452, Marion, Ind.

Wanted—First-class tool-dresser and temperer; one who can forge and temper lathe tools in A No. 1 shape; none other need apply; must be strictly temperate. Vt. Farm Machine Co., Bellows Falls, Vt.

Blacksmiths.—Two good general machine blacksmiths for light and medium forging on anvil and under steam hammer; give age and experience; location, Western Pennsylvania. Apply by letter to Box 187, AMER. MACH.

Machinists and vise men who can work to drawing on small interchangeable work; state length of experience and with what firm previously employed; none but good men need apply. Box 114, AMER. MACH.

Wanted—Bench and floor machine hands for automobile and marine gasoline motor work, also young mechanics to break in as operators; give experience, reference and wages expected. Box 151, AMER. MACHINIST.

Wanted—Toolmakers familiar with such work as cash register, gun and watch tools; applicants please state experience and wages expected; do not apply unless familiar with work such as outlined above. Box 128, A. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Salesman wanted who thoroughly understands filter press business; only those having a thorough knowledge of the trade in the East need apply; excellent position and good salary for the right man. Address "Liberty," care AMERICAN MACHINIST.

Wanted—In a good small shop within 100 miles of New York, a fitter of the best class, also a man expert on the vertical miller and cutter; good locality; permanent and immediate employment; no strike; write, stating wages wanted. Box 176, AMER. MACHINIST.

Draftsmen Wanted.

We have positions open for capable, experienced Mechanical Draftsmen. Our business is to assist Draftsmen and Engineers (technical men only) to secure positions when unemployed, and to better their positions when employed. Our business was established in 1893.

No registration fee. **THE ENGINEERING AGENCY, 1605 Monadnock Block, CHICAGO.**

OHIO STATE UNIVERSITY, COLUMBUS, College of Engineering. Nine four year courses leading to Engineering degrees. Three short courses. Total expense, including all fees, board, room and books, may be under $200.00. Many students are self-supporting. Credit given for shop and drawing room experience. Catalog on application to executive office.

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